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V/STOL MODEL FAN STAGE RIG DESIGN REPORT

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16. Abstract

A model single-stage fan with variable inlet guide vanes (VIGV) has been designed to demonstrate efficient design point operation while providing flow and pressure ratio modulation capability required for a V/STOL propulsion system. The fan stage incorporates a split-flap VIGV with an independently actuated ID flap to permit independent modulation of fan and core engine airstreams, a flow splitter integrally designed into the blade and vanes to completely segregate fan and core airstreams in order to maximize core stream supercharging for V/STOL operation, and an EGV with a variable leading edge fan flap for rig performance optimization.

The stage was designed for a maximum flow size of 37.4 kg/s (82.3 lb/s) for compatibility with LeRC test facility requirements. Design values at maximum flow for blade tip velocity and stage pressure ratio are 472 m/s (1550 ft/s) and 1.68, respectively.

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SECTION I
SUMMARY

A program has been conducted under Contract NAS3-22779 to design a model single-stage fan rig with variable inlet guide vanes capable of providing the flow and pressure ratio modulation required for a V/STOL propulsion system while maintaining constant rotor speed. The rig was designed for testing within the NASA LeRC W-8 facility.

The fan stage aerodynamic design goals were to provide maximum airflow, pressure ratio and engine thrust at takeoff for maximum attitude control which was 25% above the thrust level at the nominal takeoff condition. The takeoff maximum control operating point specific flow (1.82 kg/sec m^2 — 43 lbm/sec ft^2), pressure ratio (1.68), tip speed (472 m/sec — 1550 ft/sec) and bypass ratio (6.35) were determined from a canvas of airframers. Stall margin (15%) and thrust modulation (40-125%) were established by the statement of work. Maximum rig flow size (37.4 kg/sec — 82.3 lbm/sec) was determined by the NASA LeRC W-8 facility.

The resulting fan stage incorporates the following features into the aeromechanical design:

- A flow splitter which extended from the VIGV leading edge through rotor and EGV to prevent mixing of the core and fan airstreams,

- A split flap VIGV with independently activated ID and OD flaps to permit independent modulation of the core and fan airstreams to maximize core stream supercharging for V/STOL operation, and

- An EGV with a variable leading edge fan flap for rig performance optimization. Predicted adiabatic efficiencies at nominal takeoff for the core, fan, and overall fan stage were 85.0, 82.7 and 83.0%, respectively.

The fabrication and assembly of the V/STOL model fan stage rig was cancelled due to NASA funding priorities and the contract effort terminated with the completion of the hardware drawings.

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SECTION II
INTRODUCTION

One of the basic requirements of a V/STOL aircraft propulsion system is the capability for rapid thrust modulation for attitude control during takeoff and landing. This capability has been demonstrated in previous V/STOL concepts through the use of variable inlet guide vanes (VIGV) to vary the flow and pressure ratio of the fan at constant rotor speed and thus modulate the propulsive thrust of the engine. Other V/STOL requirements include high thrust to weight ratio which is necessary for vertical flight, and low specific fuel consumption which is desired for maximum aircraft range. Of equal importance for operational considerations in multi engine aircraft is the capacity to maintain sufficient attitude control to perform an emergency vertical landing with one inoperative engine. To meet these stringent V/STOL requirements, a VIGV fan stage has been designed employing unique design features to provide a highly responsive, flexible means of thrust modulation while optimizing aerodynamic performance to give maximum thrust with minimum core engine size.

The fan stage employs a split-flap VIGV with an independently actuated ID flap to allow separate modulation of fan and core airstreams. The stage also employs a flow splitter which is extended forward by incorporating it into the blade design to separate the fan and core airstreams and prevent mixing between the higher pressure core stream and the fan stream. The fan blade has been designed to deliver maximum pressure ratio in the root region in order to provide maximum core supercharging and thereby reduce core engine size and weight.

The design features incorporated into the model V/STOL fan stage will enable a comprehensive rig test to demonstrate their feasibility and observe in detail the effects of VIGV variation on a typical V/STOL fan stage. The rig test will evaluate the various methods of maximizing core engine supercharging to minimize weight which will be useful in future cycle studies to define an optimum V/STOL engine.

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SECTION III
DESIGN STUDY

DEFINITION OF OVERALL DESIGN PARAMETERS

The overall design parameters for the model V/STOL fan stage were derived from proposal objectives expressed in the statement of work, a canvass of airframers for typical V/STOL mission requirements, and parametric studies from past and present Pratt & Whitney V/STOL designs. The statement of work specifies that the model fan stage include a variable inlet guide vane (VIGV) that will allow identification and evaluation of critical V/STOL design requirements. The model fan stage should demonstrate adequate thrust modulation capability during takeoff and hover operation while minimizing required engine size due to multi-engine cross shaft drive operation during one engine inoperative situations. For responsive attitude control, rapid thrust modulation is to be accomplished through VIGV variation with no change in rotor speed.

Figure 1 presents a typical fan map for multi-engine V/STOL operation. Maximum airflow, pressure ratio, and engine thrust occur at takeoff for maximum attitude control which is approximately 25% above the thrust level at the nominal takeoff condition. Individual fan operating points are indicated for a one engine inoperative condition where the imbalance in thrust between engines is corrected through the appropriate combination of VIGV variation on individual fan stages. The statement of work specifies a range for certain fan parameters at the nominal takeoff point as follows:

• Pressure Ratio	1.5 — 1.6
• Specific Flow (W_c/A)	1.6 kg/sec^2 (38 lbm/sec ft^2)
• Tip Speed	450 — 500 m/s (1450 — 1600 ft/sec)
• Inlet Hub/Tip Ratio	0.35 — 0.40
• Stall Margin	15%
• Thrust Modulation	40 — 125%

In addition, the model V/STOL fan stage is required to meet LeRC test facility dimensions which set the maximum outer diameter at 50.8 cm (20 in.) and the minimum exit inner diameter at 20.32 cm (8.0 in.).

A canvass of airframers was conducted to further define typical V/STOL design parameters. As a result, the following parameters were selected for the takeoff maximum control fan operating point:

• Specific Flow	1.82 kg/sec m^2 (43 lbm/sec ft^2)
• Pressure Ratio	1.68
• Tip Speed	472 m/sec (1550 ft/sec)

To determine airflow and pressure ratio at the nominal takeoff point, a normalized operating line was calculated from a PW2037 engine cycle simulation and forced through the takeoff maximum control design point. The PW2037 engine operating line was normalized for this estimate due to its similarity to the V/STOL fan stage pressure ratio and bypass ratio at maximum flow. Figure 2 displays the resulting operating line for the model V/STOL fan stage and the estimated nominal takeoff point. The relationship between fan airflow and pressure ratio to engine thrust was established from NASA tests conducted on a YTF34 engine as reported in References 1 and 2. The nominal takeoff point was estimated to be on the normalized operating line at a point corresponding to a 25% reduction in engine thrust.

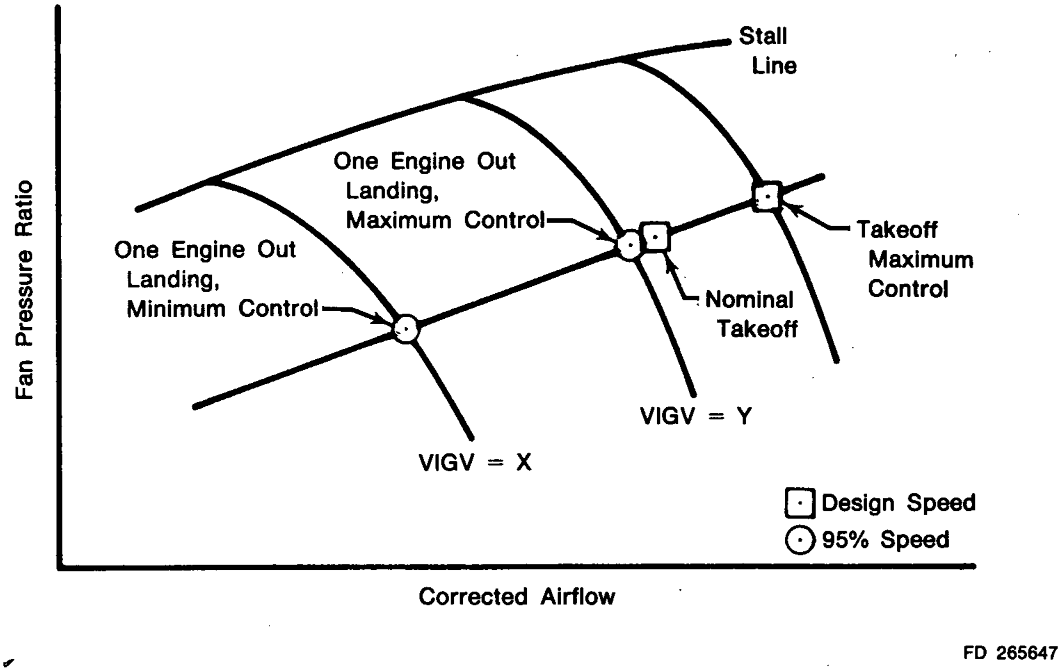

Figure 1. Typical V/STOL Fan Map

The fan bypass ratio for a representative V/STOL application at nominal takeoff was estimated from a previous V/STOL "A" parametric study in which engine size was optimized at varying fan pressure ratio and bypass ratio to satisfy thrust and one engine out requirements. Figure 3 summarizes the trade study for a tandem fan V/STOL "A" application from which high compressor flow requirements were established to permit extrapolation from a single fan V/STOL engine (STF 521). As a result of these studies, the model V/STOL fan stage bypass ratio at nominal takeoff was defined to be 6.0. Bypass ratio at the maximum control takeoff point was calculated by assuming that high compressor corrected flow did not change from nominal takeoff. The resulting bypass ratio at the maximum flow condition for the fan is calculated to be 6.35.

Efficiency for the model fan stage at the nominal takeoff condition was predicted from the Pratt & Whitney streamline design system which incorporates empirical fan blade element loss data as a function of Mach number and aerodynamic loading. This efficiency prediction is compared to state of the art efficiency versus tip speed in Figure 4.

The state of the art efficiency curve has been established by adjusting test results as follows:

- Part span shroud effects have been eliminated
- Efficiencies have been adjusted to reflect the same flow size to eliminate Reynolds number and relative roughness effects
- Efficiency is measured at 15% stall margin at design speed.

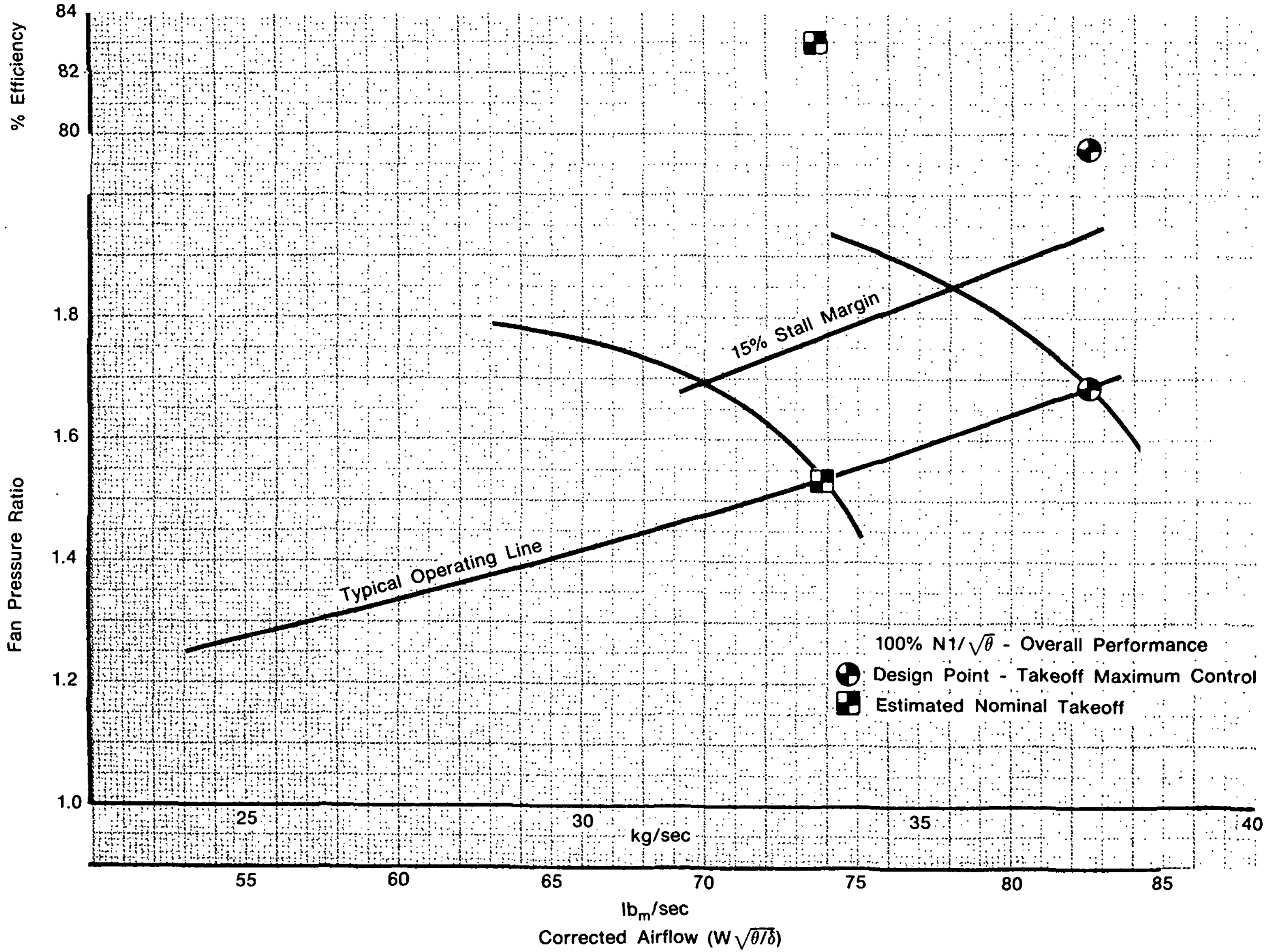

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Figure 2. V/STOL Fan Operating Line

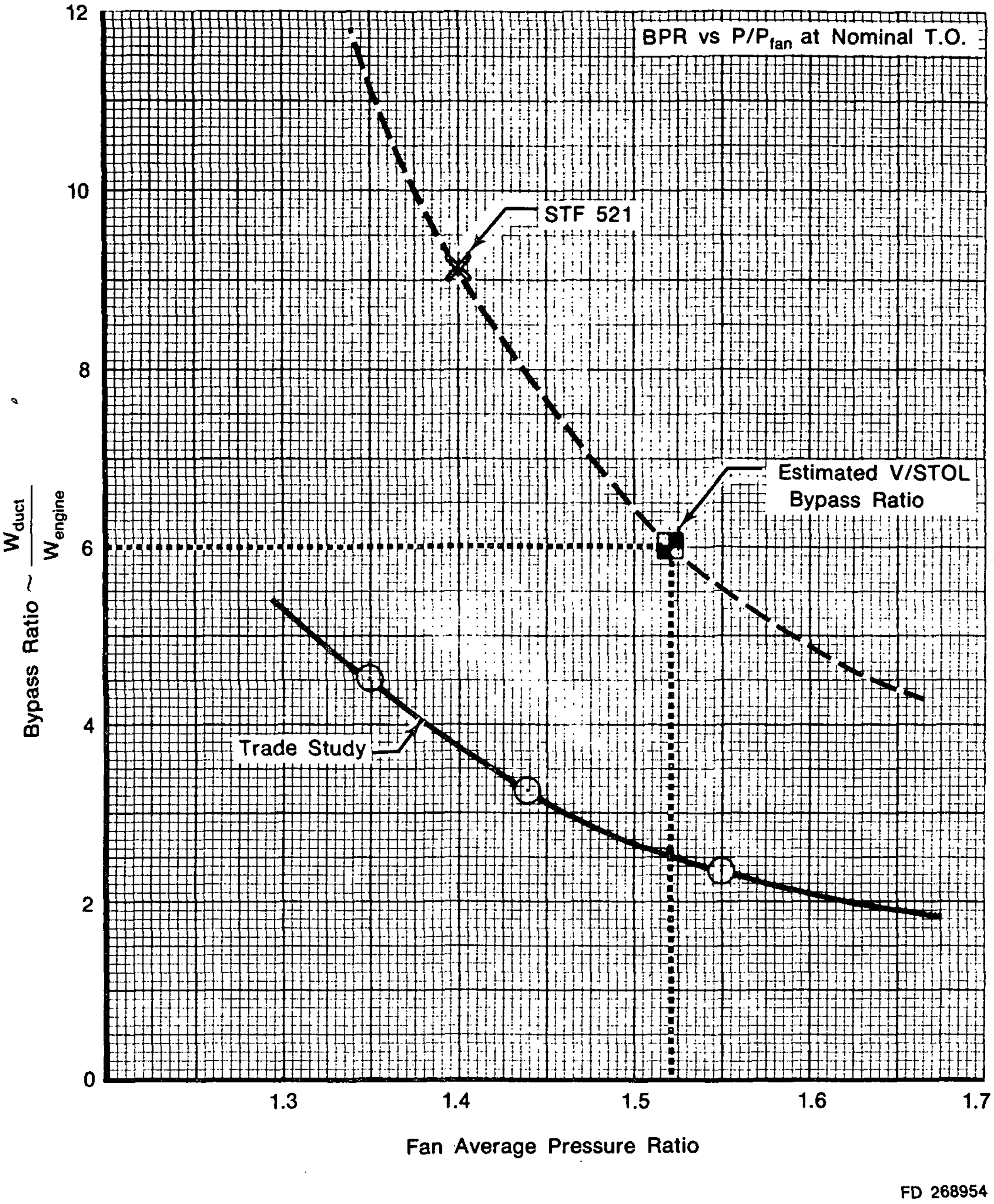

Figure 3. V/STOL Bypass Ratio Estimate

For comparison purposes, model V/STOL fan efficiency has been increased by 1.0% for part span shroud and splitter effects and 1.1% for size effects in Figure 4 and is predicted to be within 1% of state of the art technology.

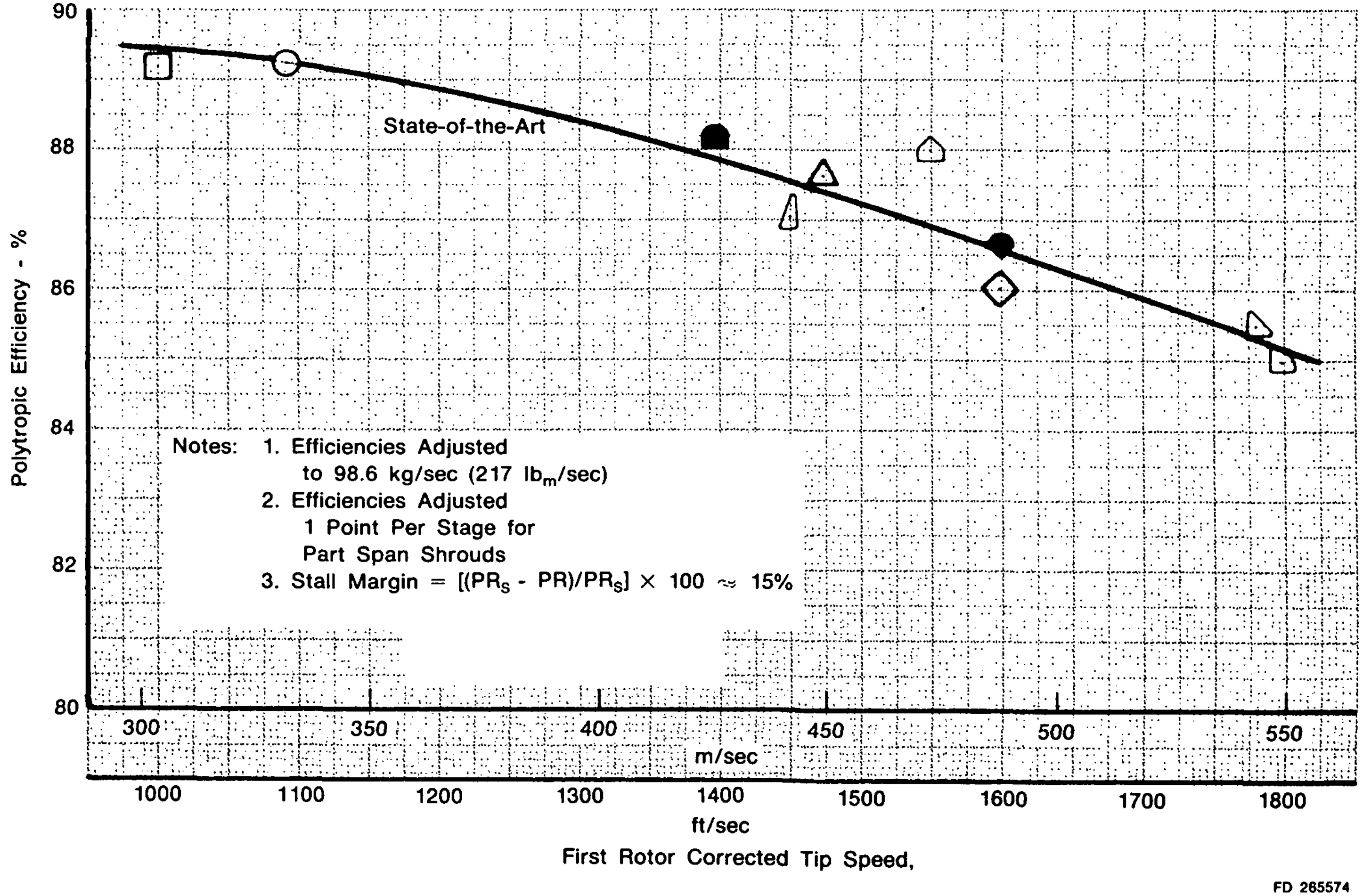

Figure 4. Fan Design Point Efficiency Comparisons

Table 1 summarizes the maximum control and nominal takeoff design points established from statement of work specifications, rig flowpath constraints, a canvass of airframers for representative parameters, and parametric studies and calculations for typical V/STOL fan applications.

TABLE 1. — V/STOL OVERALL FAN DESIGN PARAMETER

	Maximum Control Takeoff	*Nominal Takeoff*
Corrected Speed ($N/\sqrt{\theta}$) ~ RPM	17762	17762
Corrected Flow ($W\sqrt{\theta}/\delta$) ~ kg/sec	37.42 (82.32 lbm/sec)	33.50 (73.70 lbm/sec)
Pressure Ratio	1.68	1.53
Stall Margin ~ %	15	15
Adiabatic Efficiency (η) ~ %	79.5	83
Bypass Ratio	6.35	6.0
Specific Flow (W_c/A) ~ kg/sec m^2	1.82 (43 lbm/sec ft^2)	1.6 (38 lbm/sec ft^2)
Corrected Tip Speed ~ m/sec	472 (1550 ft/sec)	472 (1550 ft/sec)

Once overall fan design parameters had been established, consideration was given to identifying features unique to V/STOL applications which would improve engine performance by decreasing weight, maximizing thrust, and providing more flexible thrust modulation.

V/STOL aircraft are limited in range due to the overall engine weight which includes such items as large vane actuators, variable nozzles, additional ductwork for attitude control, and gearboxes and cross-shafts unique to V/STOL operation. Additional complexity occurs for multi-engine V/STOL aircraft with cross-shaft designs due to the one engine inoperative condition which requires that the gas generator of one engine drive the fans of both engines to provide thrust and attitude control for emergency landing. During emergency landing, the fan of the inoperative engine must run with its VIGV open to offset the loss of engine thrust. The fan of the operative engine must run with its VIGV closed to equalize engine thrust and provide attitude control while its gas generator provides the power to drive both fans. The power requirement during emergency landing determines the size of the core engine and has a large impact on engine weight. Consequently, it is desirable that the fan VIGV in the operable engine not desupercharge the core flow while operating with closed vanes to achieve balanced thrust with attitude control margin.

A part-span VIGV has been successfully tested at NASA LeRC on a YTF34 engine to modulate thrust and improve the desupercharging condition during one engine inoperative conditions. The results of these tests are described in References 1 and 2. The part-span VIGV does not modulate the core stream coming into the fan blade; consequently, core pressure ratio does not decrease as much as fan OD pressure ratio during VIGV closure. The tests indicate that the core pressure ratio drop may be further reduced by extending a flow splitter upstream toward the blade trailing edge to reduce mixing between the higher pressure core stream and the lower pressure fan stream. A reduction in core size of 12% is reported to be achievable for a part-span VIGV relative to a full-span VIGV configuration. An additional 2% core size reduction is estimated when a flow splitter extension is included. The reduced core size, improved cruise SFC, and decreased engine weight will provide substantial benefits to a V/STOL aircraft

Even with a part-span VIGV fan, a significant reduction in core pressure ratio occurs as the fan stream VIGV closes and fan stream pressure ratio is reduced due to mixing and communication between fan and core streams. In the configuration proposed for the model V/STOL fan stage shown in Figure 5, a flow splitter has been incorporated into the blade design to allow extension upstream through the VIGV. An independently actuated ID flap on the VIGV is provided for core stream airflow. The flow splitter completely isolates the core stream

from the fan stream to eliminate any desupercharging effect. In addition, the ID flap is available to provide additional supercharging to the core stream regardless of the setting of the fan OD flap. Isolation of the core stream alone should permit a reduction in core size of 8% according to the referenced reports. By supercharging with the ID flap, additional reduction in core size should be achievable depending on stall margin and turbine inlet temperature limits. The benefits over competing designs of an isolated core stream, split-flap VIGV fan design for multi-engine V/STOL application which include reduced engine weight, improved SFC, and more flexible thrust modulation capability may be assessed relative to its added cost and complexity in the model V/STOL fan stage rig test program.

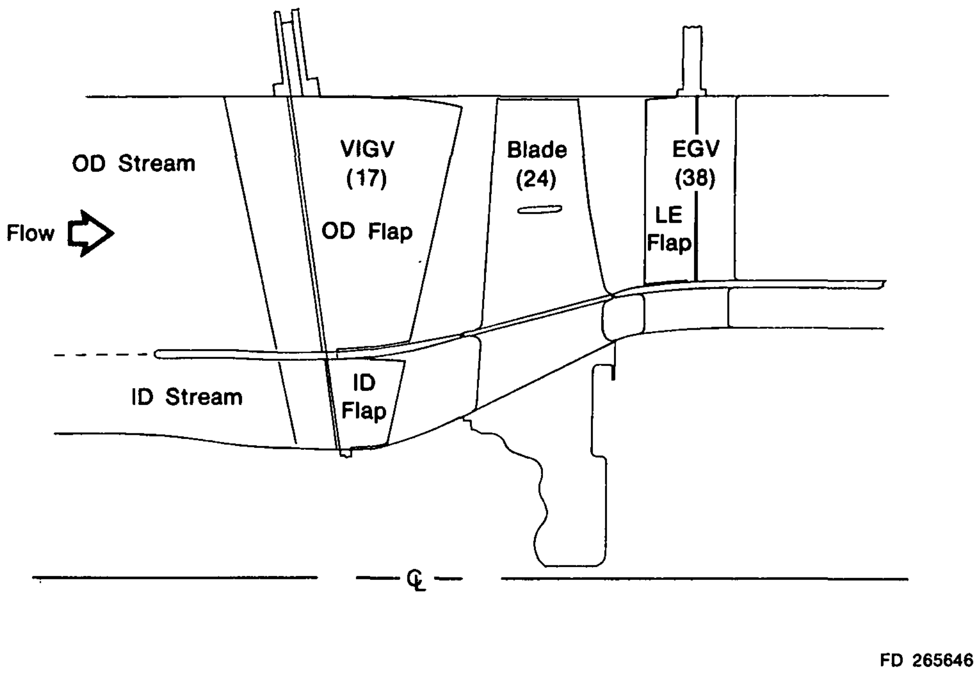

Figure 5. V/STOL Fan Flowpath

Also included in the model V/STOL fan stage configuration is a variable leading edge flap for the fan exit guide vane (EGV). The purpose of the variable flap is to align incidence into the EGV and, thereby reduce loss through the OD vane. This flap is desirable in the rig test for optimization and trade studies of fan performance over the wide range of incidence encountered during VIGV modulation. This configuration will enable the rig test to assess the feasibility of including a leading edge EGV flap in a full-scale V/STOL engine.

PRELIMINARY DESIGN RESULTS

Once overall design parameters were determined and the basic configuration was selected, a preliminary design analysis was performed using the Pratt & Whitney Equivalent Cone Angle (ECA) Meanline Design Program. The meanline analysis was used to define the flowpath and meanline aerodynamics at the maximum flow condition to balance the aerodynamic loading between the blade and vane. Meanline studies resulted in the definition of aspect ratio, solidity, number of airfoils, and average chord which provide sufficient loading capability to ensure 15% stall margin at maximum flow. Table 2 presents meanline design parameters for the overall fan stage as well as core and fan streams. Figure 6 illustrates that the work and loading levels of the

V/STOL fan stage as derived from the meanline studies are within the experience level demonstrated by previous fan designs.

TABLE 2. — V/STOL FAN MEANLINE DESIGN PARAMETERS (FROM PRELIMINARY DESIGN)

	Overall	*ID Stream*	*OD Stream*
$N_I/\sqrt{\theta}$ ~ rpm	17762	17762	17762
$W\sqrt{\theta}/\delta$ ~ kg/s	37.42 (82.32 lbm/s)	5.09 (11.2 lbm/s)	32.33 (71.12 lbm/s)
Pressure Ratio	1.68	1.74	1.66
Efficiency	76.6	81.9	75.8
Bypass Ratio	6.35	—	—
Stall Margin	15.0	15.0	15.0
VIGV	+18°	+18°	+18°
U_{TIP} ~ m/s	472.0 (1550 ft/s)	236.5 (776 ft/s)	472.0 (1550 ft/sec)
Wc/A ~ kg/s · m^2	1.82 (43 lbm/s · ft^2)	1.70 (40.3 lbm/s · ft^2)	1.87 (44.4 lbm/s · ft^2)
Λ_{IN}	0.35	0.70	0.52
Λ_{OUT}	0.52	0.87	0.61
Exit Mn	0.46	0.68	0.48
D_F	0.40	0.35	0.41
ΔP/Po-P	0.36	0.38	0.33
E'	0.66	1.51	0.60
$(Cx/U)_2$	0.48	0.93	0.48
AR	2.1	0.40	1.63
σ	1.58	2.26	1.54
$(NoA)_{w/o\ IGV}$	62	62	62
Length ($R1_{LE}$-$S1_{TE}$) ~ cm	13.72 (5.40 in.)	13.72 (5.40 in.)	13.72 (5.40 in.)
R1 OD ~ cm	50.8 (20.0 in.)	25.4 (10.0 in.)	50.8 (20.0 in.)
Flowpath	COD	MIXED	COD

The fundamental premise of a V/STOL fan design with a variable inlet guide vane is that fan airflow and pressure ratio can be modulated by large amounts without a change in rotor speed through manipulation of the VIGV. This manipulation necessitates a VIGV with more turning capability than is found in conventional fan designs. Figure 7 illustrates the typical range of flap positions that a V/STOL fan stage encounters from maximum to minimum control at a given speed. The VIGV solidity level required to achieve the turning necessary for V/STOL performance was verified through calculation of the Zweiffel loading coefficient for accelerating cascades. Table 3 presents a comparison of basic geometry between the part-span YTF34 VIGV of References 1 and 2 and the model V/STOL fan stage. The similar gap-to-chord and aspect ratio of the two designs further verify the turning capability of the V/STOL VIGV.

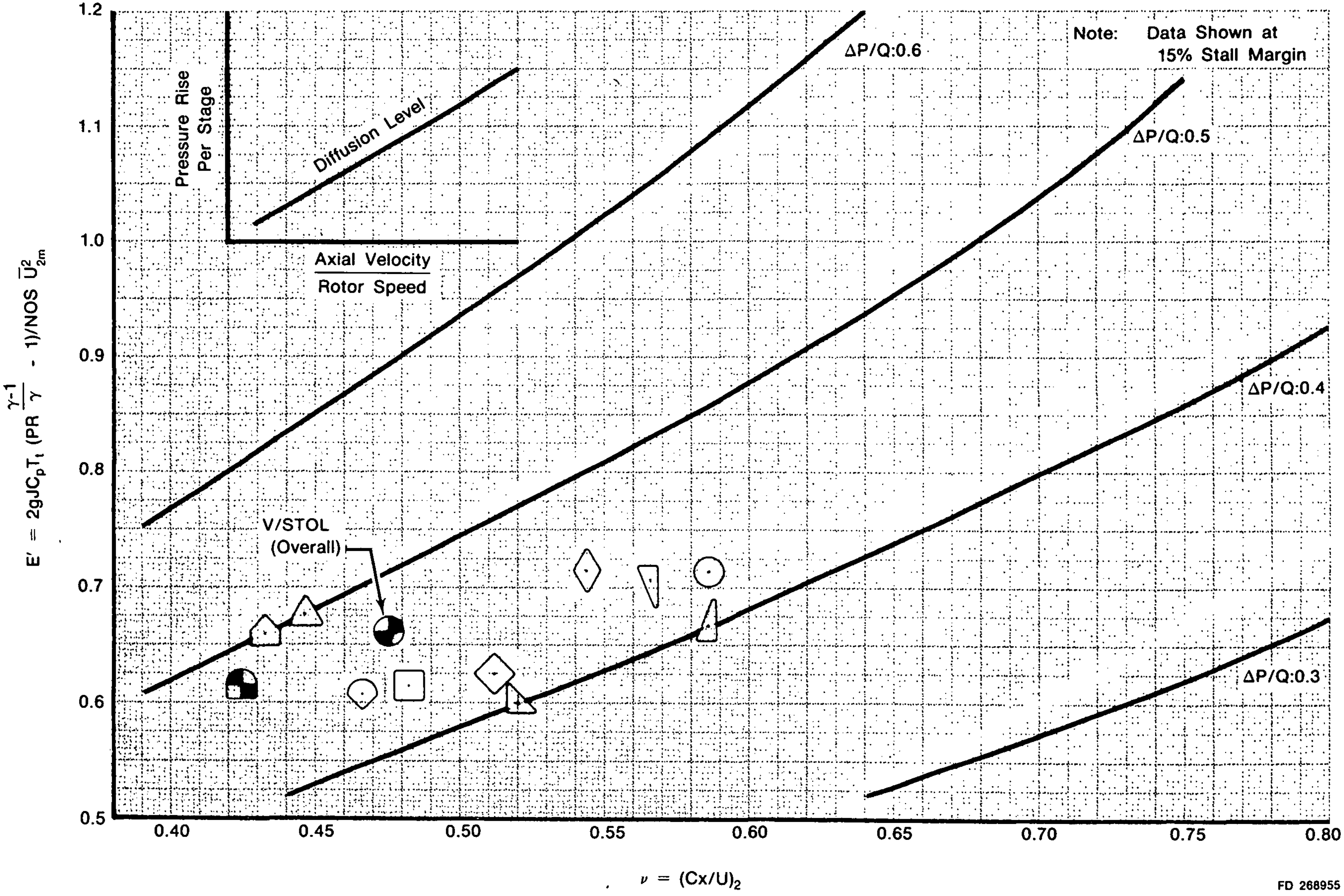

Figure 6. Fan Work/Loading Experience

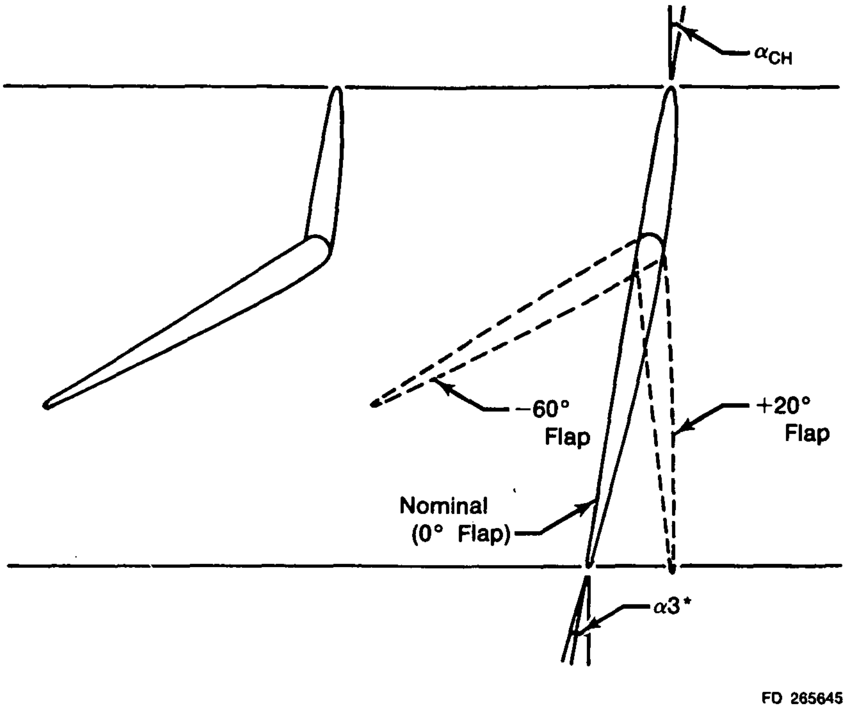

Figure 7. V/STOL Fan VIGV — Tip Section

TABLE 3. — VIGV COMPARISON

		YTF34 P.E.T. (Part Span VIGV)			*P&WA V/STOL (Split Flap IGV)*		
		ID	*Hub*	*Tip*	*ID*	*Split*	*Tip*
% Span		100	66.1	0	100	73.3	0
Average Diameter ~	cm	34.29	60.50	111.66	13.72	23.62	20.0
	(in.)	(13.5)	(23.82)	(43.96)	(5.4)	(9.30)	(7.874)
Chord ~	cm	—	8.573	17.734	4.788	6.894	4.987
	(in.)	—	(3.375)	(6.982)	(1.885)	(2.714)	(1.963)
τ/b		—	0.739	0.659	0.53	0.631	0.74
Chord — Flap ~	cm	—	4.257	12.842	2.248	4.013	3.487
	(in.)	—	(1.676)	(5.056)	(0.885)	(1.580)	(1.373)
τ/b — Flap		—	1.488	0.911	1.128	1.088	1.060
t_{max} ~	cm	—	0.754	1.270	0.635	0.635/0.794	0.3125
	(in.)	—	(0.297)	(0.500)	(0.25)	(0.25/0.3125)	(0.123)
t/b		—	0.088	0.072	0.128	(0.091/0.113)	0.063
LER/b		—	0.021	0.014	0.014	0.008	0.003
TER/b		—	0.015	0.010	0.114	0.010	0.006
Number of Airfoils			30			17	
Airfoil Series			63			63	
Flap Camber			0°			~6°	
BPR			6.2			6.0	
Aspect Ratio			1.84			1.90	

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SECTION IV
AERODYNAMIC DESIGN

RADIAL AERODYNAMIC DESIGN RESULTS

After establishing overall design parameters and completing the preliminary design to define average row geometry and performance, the resulting rig configuration shown in Figure 5 was analyzed using the Pratt & Whitney streamline analysis program. This program performs an axisymmetric, radial equilibrium analysis of the flow field using a streamline curvature solution technique to radially define aerodynamic parameters at airfoil leading and trailing edge stations.

Preliminary studies were performed using the streamline analysis to optimize preswirl and work distribution radial effects on fan stage aerodynamics at the nominal takeoff point. Figure 8 illustrates the effects of three possible swirl distributions on fan blade loss, aerodynamic loading, and Mach number. By placing maximum preswirl at the tip and counterswirl at the hub, blade Mach number and loss were reduced at the tip while aerodynamic loading was reduced at the hub. As a result of this study, a nominal VIGV exit air angle distribution was defined featuring 12 degrees of preswirl at the OD varying to no preswirl for the ID stream.

The effect of supercharging the core airstream to minimize core engine size by varying the design stage radial work distribution was evaluated in a streamline analysis study as shown in Figure 9. The figure compares the exit Mach number and turning of a design with a constant spanwise pressure profile versus a design with a total pressure profile increased at the hub to provide 10% supercharging to the core airstream. For the same average fan pressure ratio, the supercharging work distribution requires considerably more turning at the hub and small negative turning near the tip as contrasted to the more moderate turning for a flat pressure profile. Blade loading limits for 15% stall margin determine the amount of pressure rise and turning which can be achieved at the blade hub. From evaluation of blade aerodynamic loading from streamline studies with varying amounts of core supercharging, the total pressure profile displayed in Figure 10 was defined for the maximum flow point. The core supercharging achieved by this profile was approximately half the 10% level initially attempted. The 10% level appears unrealistic due to hub loading and turning requirements. In addition, the absence of work in the blade tip sections where work capability is greatest raises the question as to whether such a design is providing the most effective use of fan work capability. The rig test of an isolated core stream, split-flap VIGV fan stage where supercharging can be adjusted through ID and OD flap variation may provide a basis for additional engine cycle studies to define the fan/core work levels for optimum V/STOL engine performance.

Fan blade loading for the ID and OD airstreams at the maximum flow point are shown in Figures 11 through 13 in the form of diffusion factor and $\Delta P/(Po\text{-}P)$ versus span. Predicted blade loading levels at 15% and 20% stall margin for the OD and ID air streams are compared to demonstrated rotor loading levels at surge for previous designs in Figures 14 and 15. The demonstrated loading levels at surge substantiate V/STOL blade loading which will allow the fan stage to demonstrate adequate stall margin for a V/STOL engine application. Figure 16 substantiates overall blade loading for the V/STOL stage relative to peak diffusion factor demonstrated as a function of blade aspect ratio.

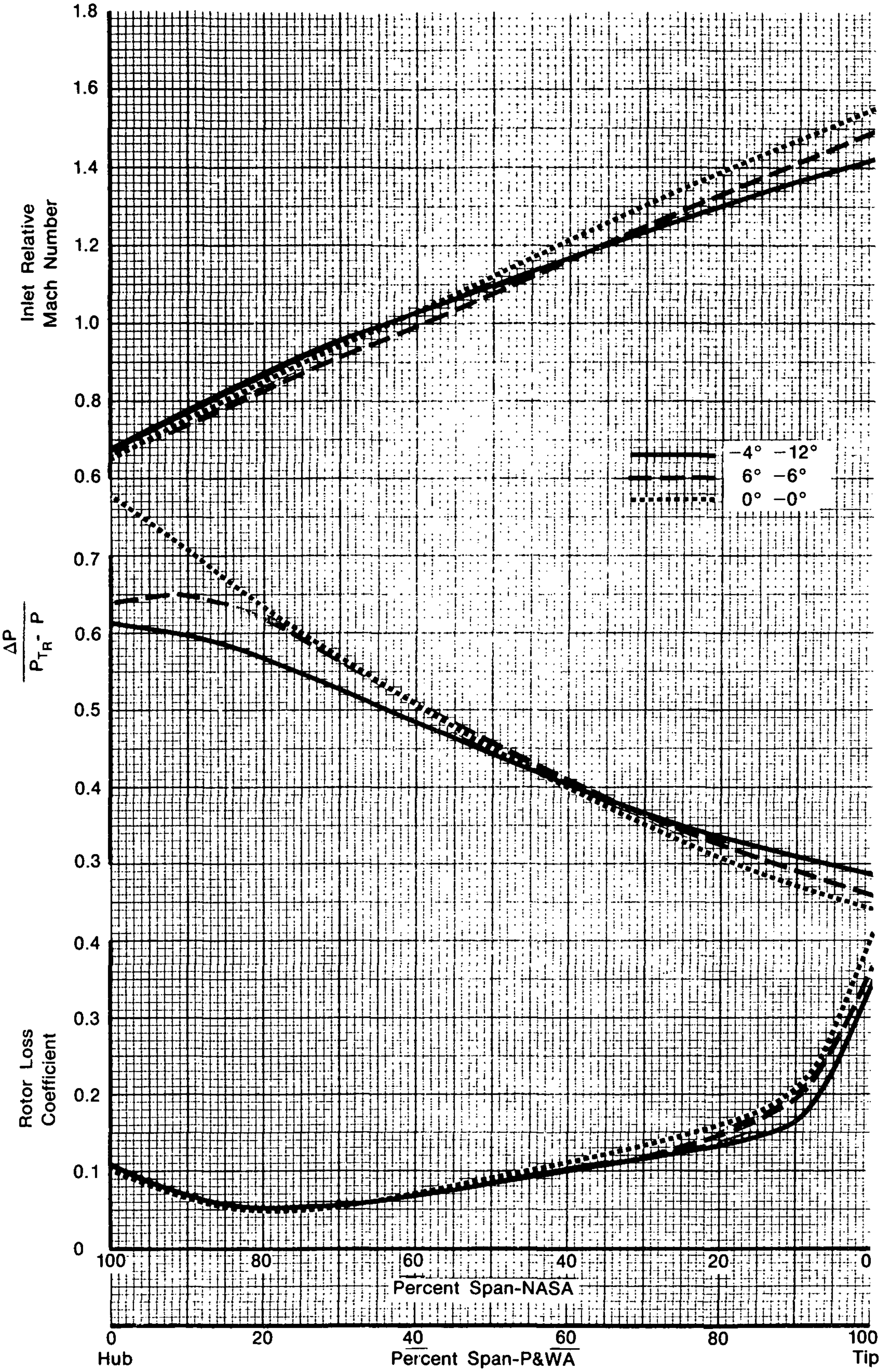


Figure 8. Preswirl Effects at Nominal Takeoff

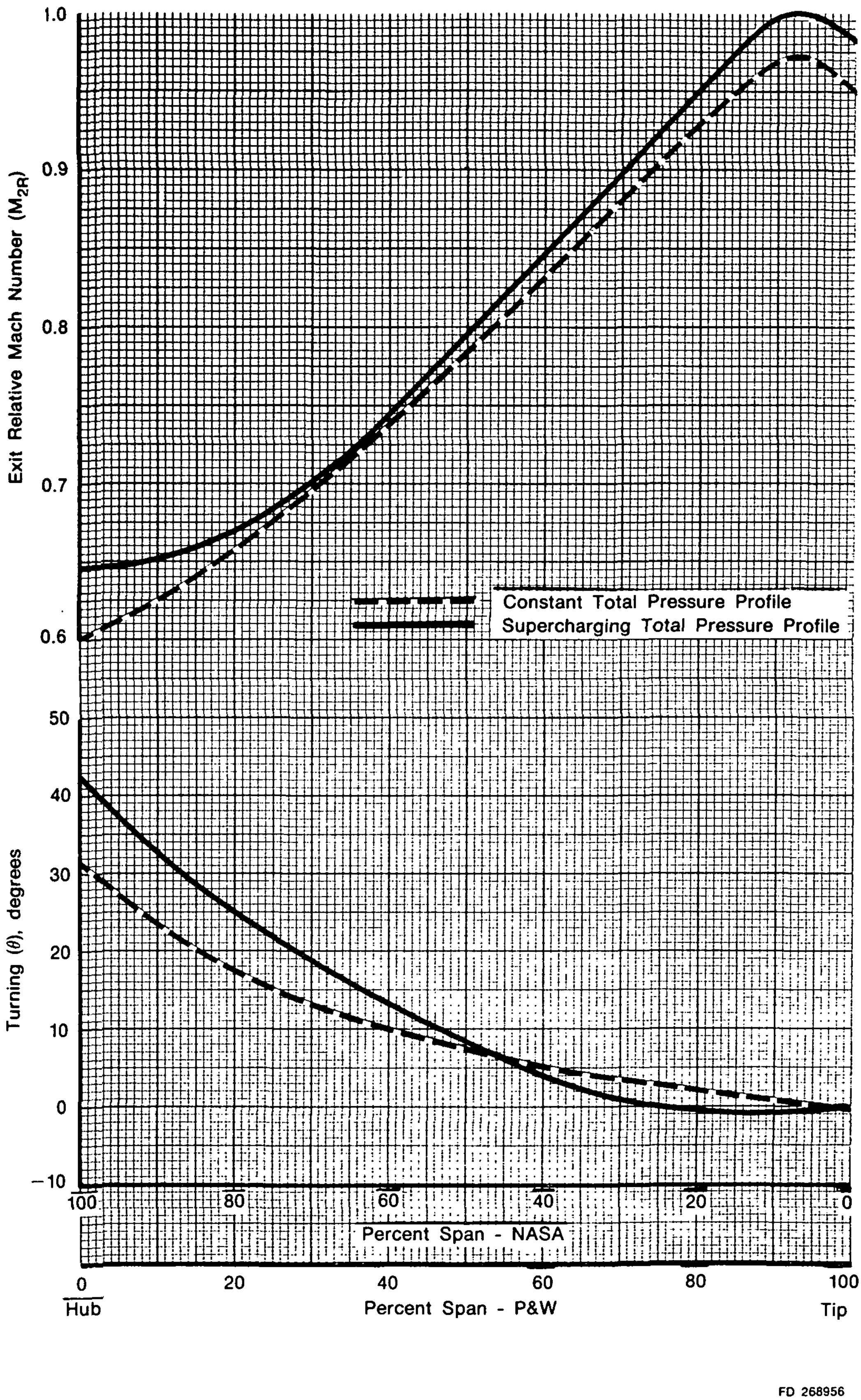


Figure 9. Effect of P_T Profile at Nominal Takeoff

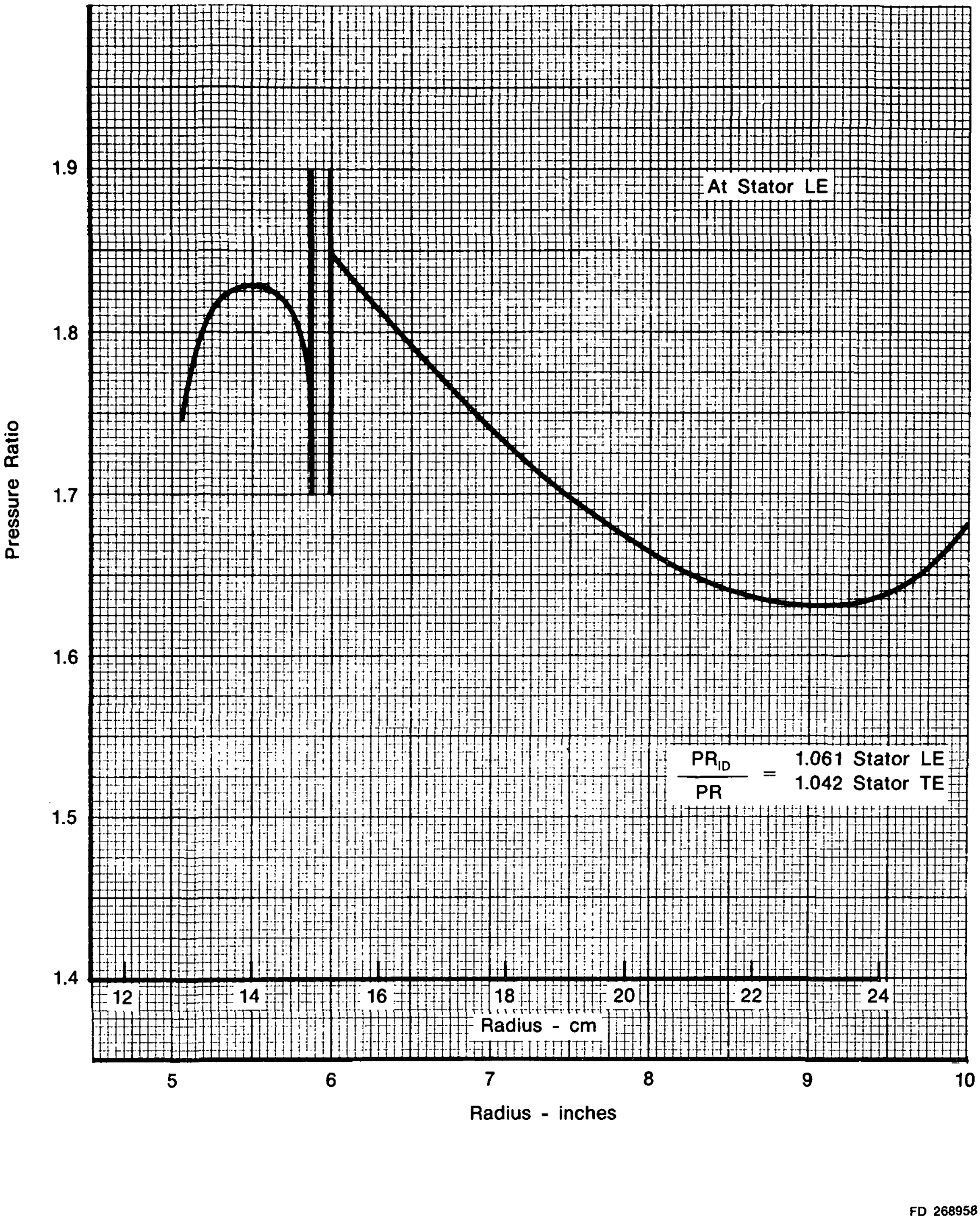
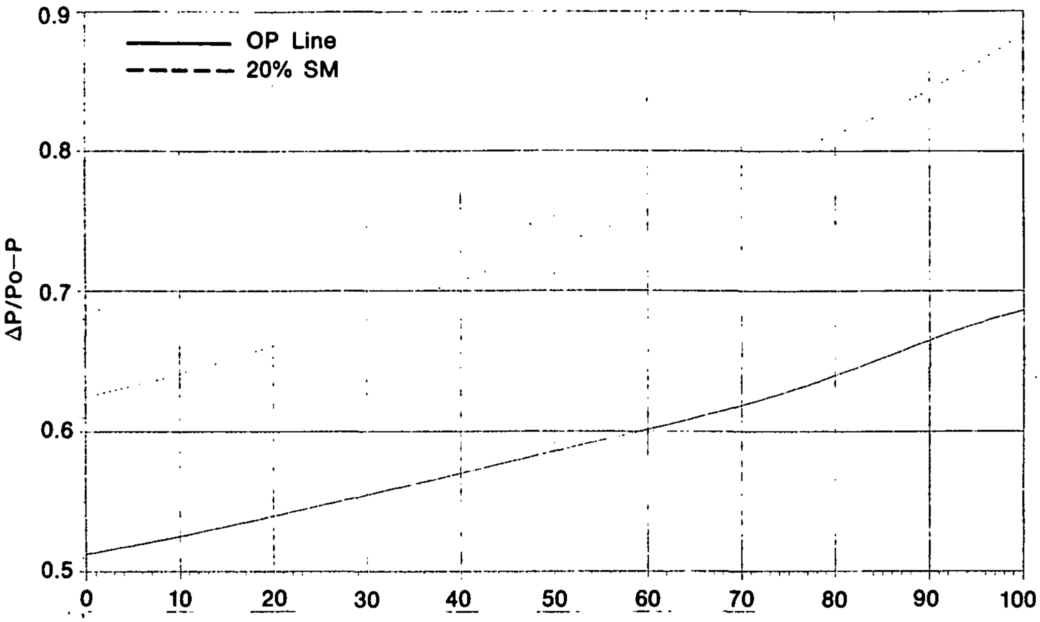


Figure 10. Total Pressure Profile Supercharging Effect at Max Control T.O.



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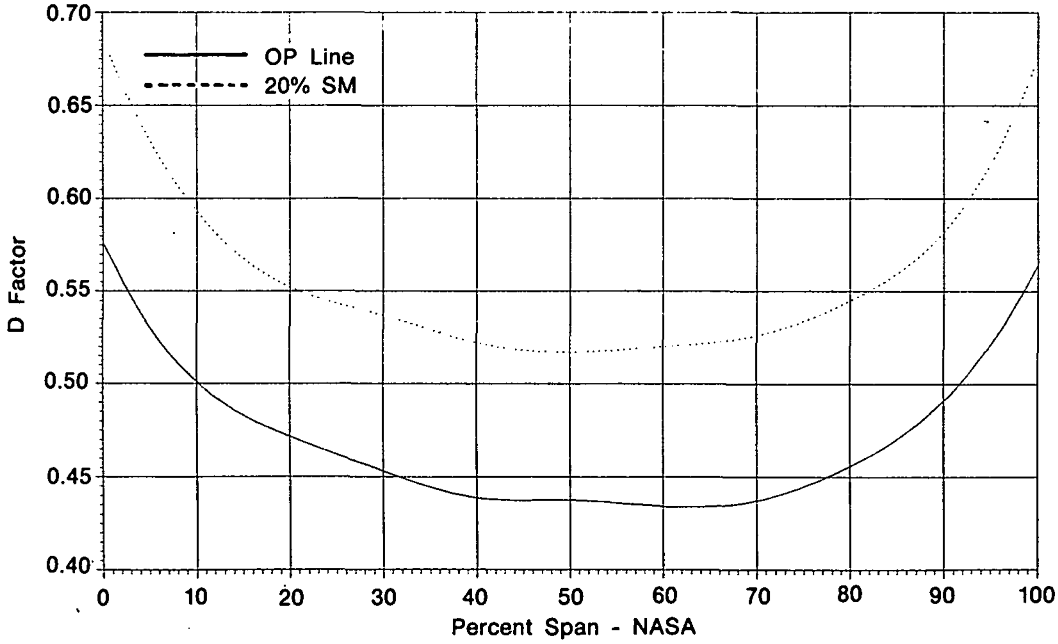

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Figure 11. V/STOL Fan Blade Loading ID Stream at Max Control T.O.

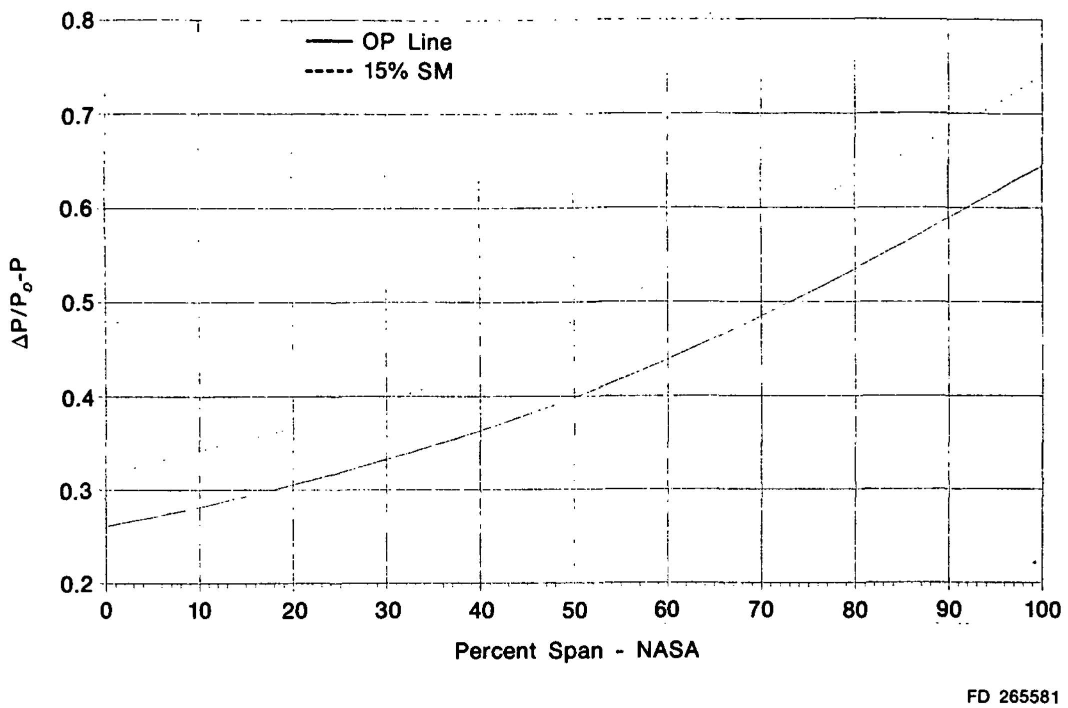

Figure 12. V/STOL Fan Blade Loading OD Stream at Max Control T.O.

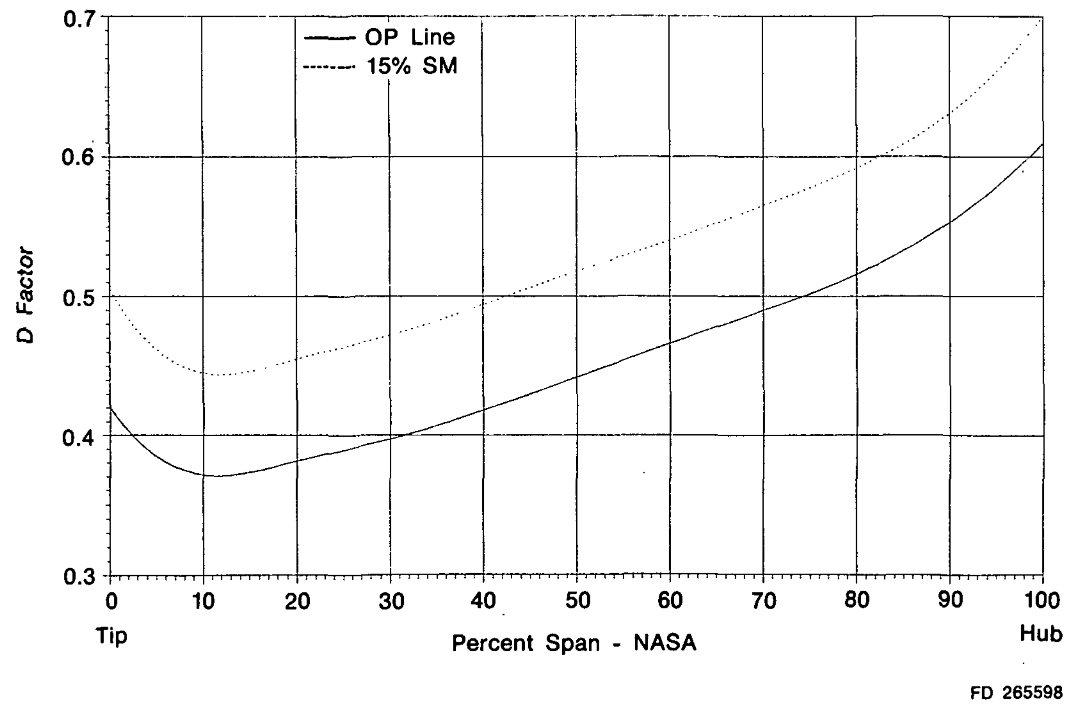

Figure 13. V/STOL Fan Blade Loading OD Stream at Max Control T.O.

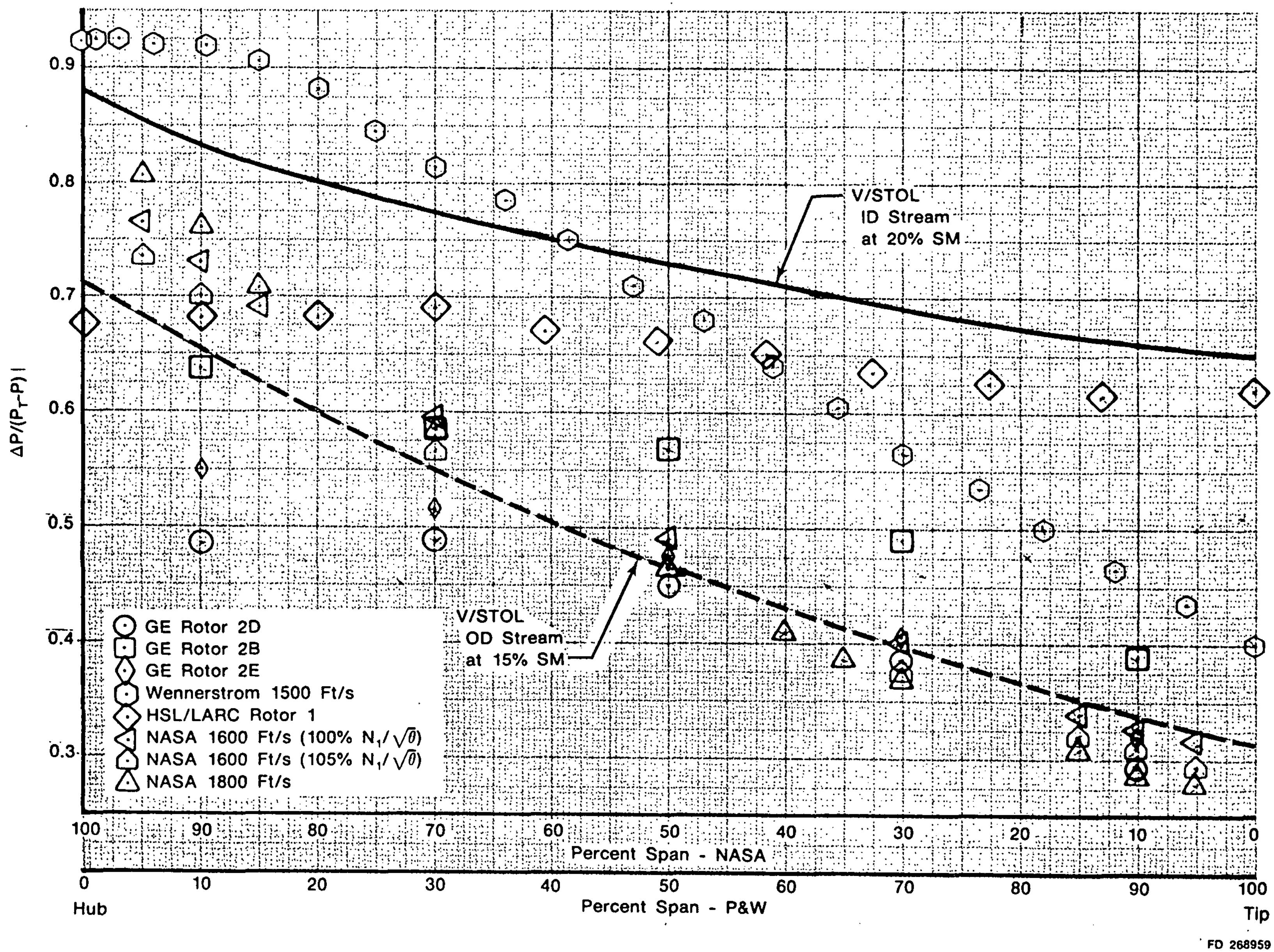

Figure 14. Rotor Loading Experience at Surge

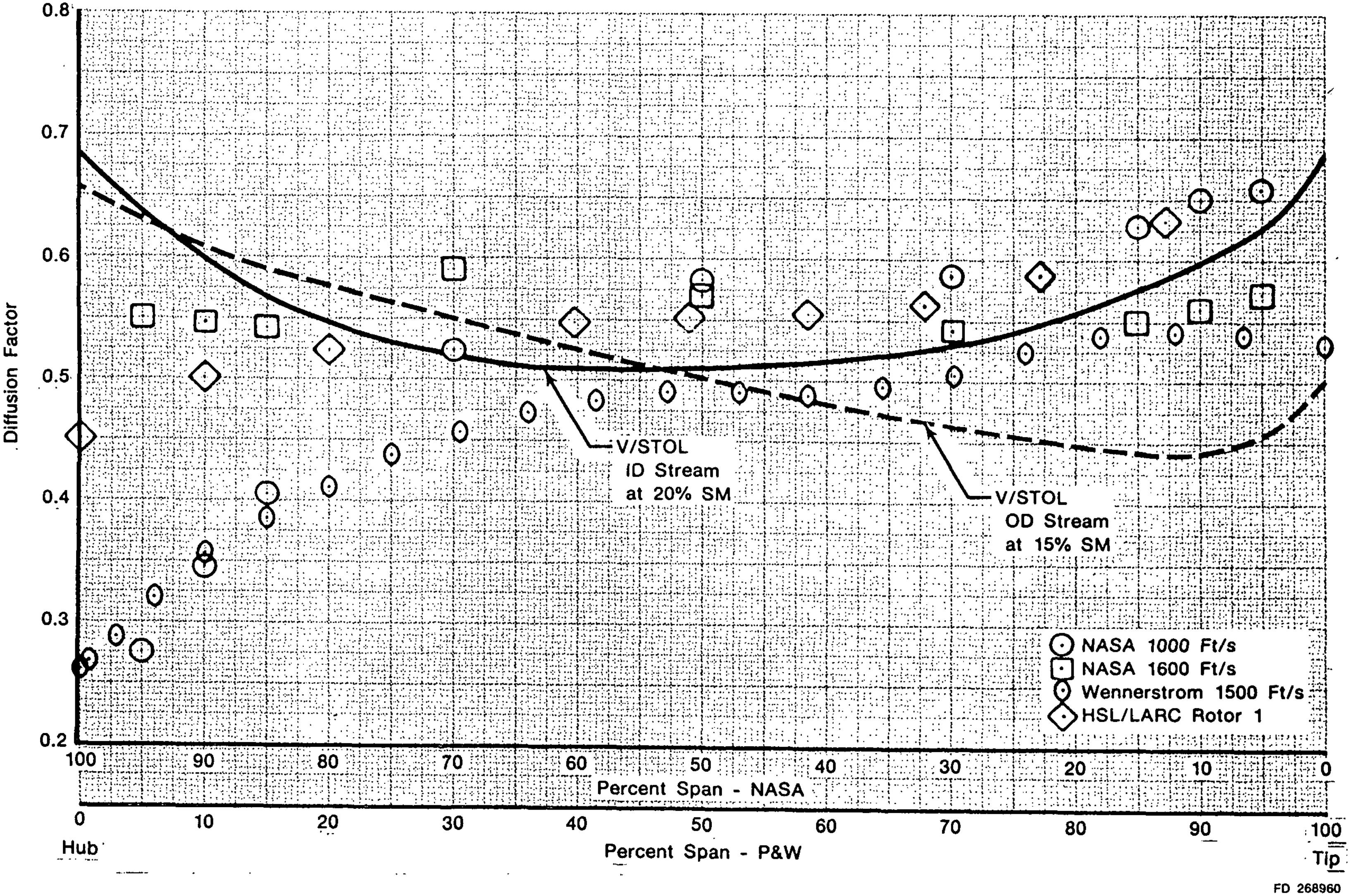

Figure 15. Rotor Loading Experience at Surge

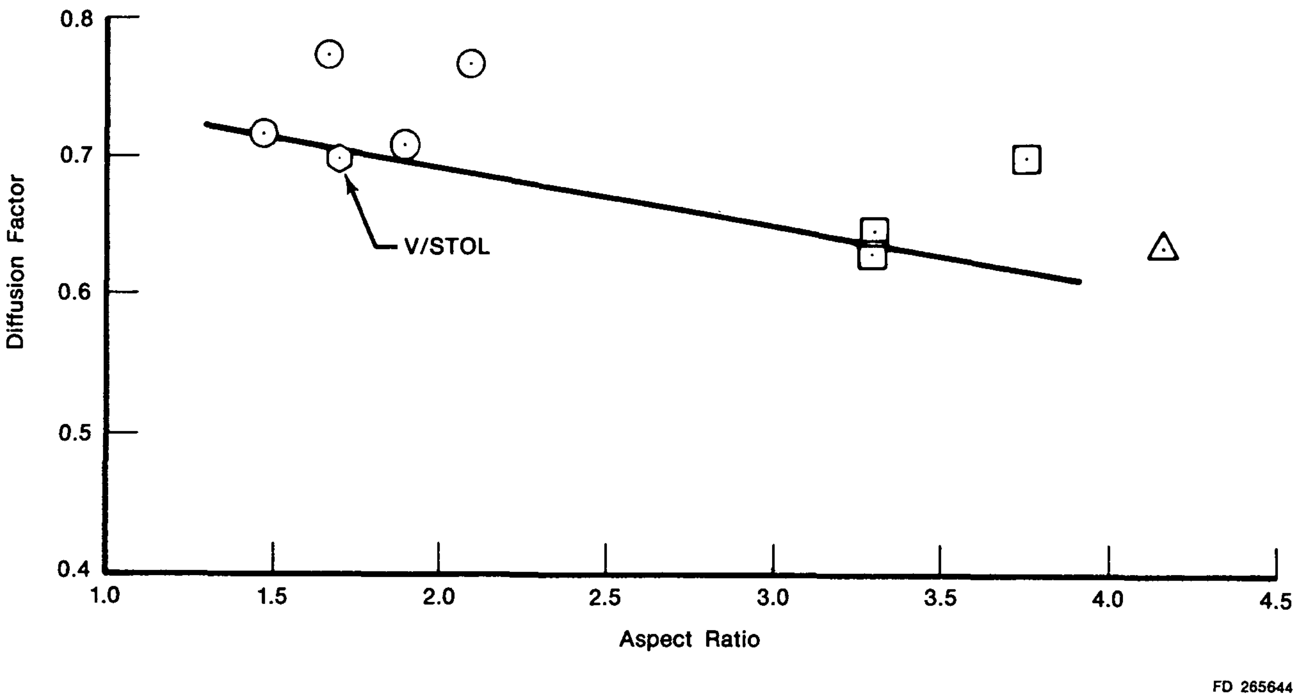

Figure 16. Comparative Fan Loading

Aerodynamic loading for the V/STOL fan stage exit vanes is displayed in Figures 17 and 18 at the maximum flow point. Both ID and OD stators are more lightly loaded than the blade and are not expected to limit fan stall line at the maximum flow VIGV setting.

Table 4 summarizes V/STOL fan stage performance as predicted by the final streamline analysis for the maximum flow and nominal takeoff design points which correspond to VIGV settings of +18 and zero degrees, respectively. Stage performance as well as blade and vane loadings are given for ID, OD, and combined overall airstreams.

A detailed tabulation of velocity triangle components, Mach numbers, loading parameters, and overall airfoil row performance is given in both metric (SI) and English notation for each airfoil row in Appendix A. The information is independently tabulated for ID (core) and OD (fan) airstreams at both nominal and maximum control takeoff points.

DEFINITION OF METAL GEOMETRY

Once aerodynamic parameters had been defined for maximum control and nominal takeoff design points to satisfy the flow, efficiency, and stall margin requirements of the V/STOL fan stage, metal geometry was defined for the blade and vanes by employing empirical incidence, deviation, and choke margin criteria in the Multiple Circular arc (MCA) blading program to radially define airfoil section metal angles. The MCA blading program is based on a simplified blade channel flow model in which an airfoil is constructed around a multiple circular arc mean camber line. The program lends itself well to using empirical criteria to optimize camber, chord, and thickness distributions along the mean camber line from which airfoil sections are defined.

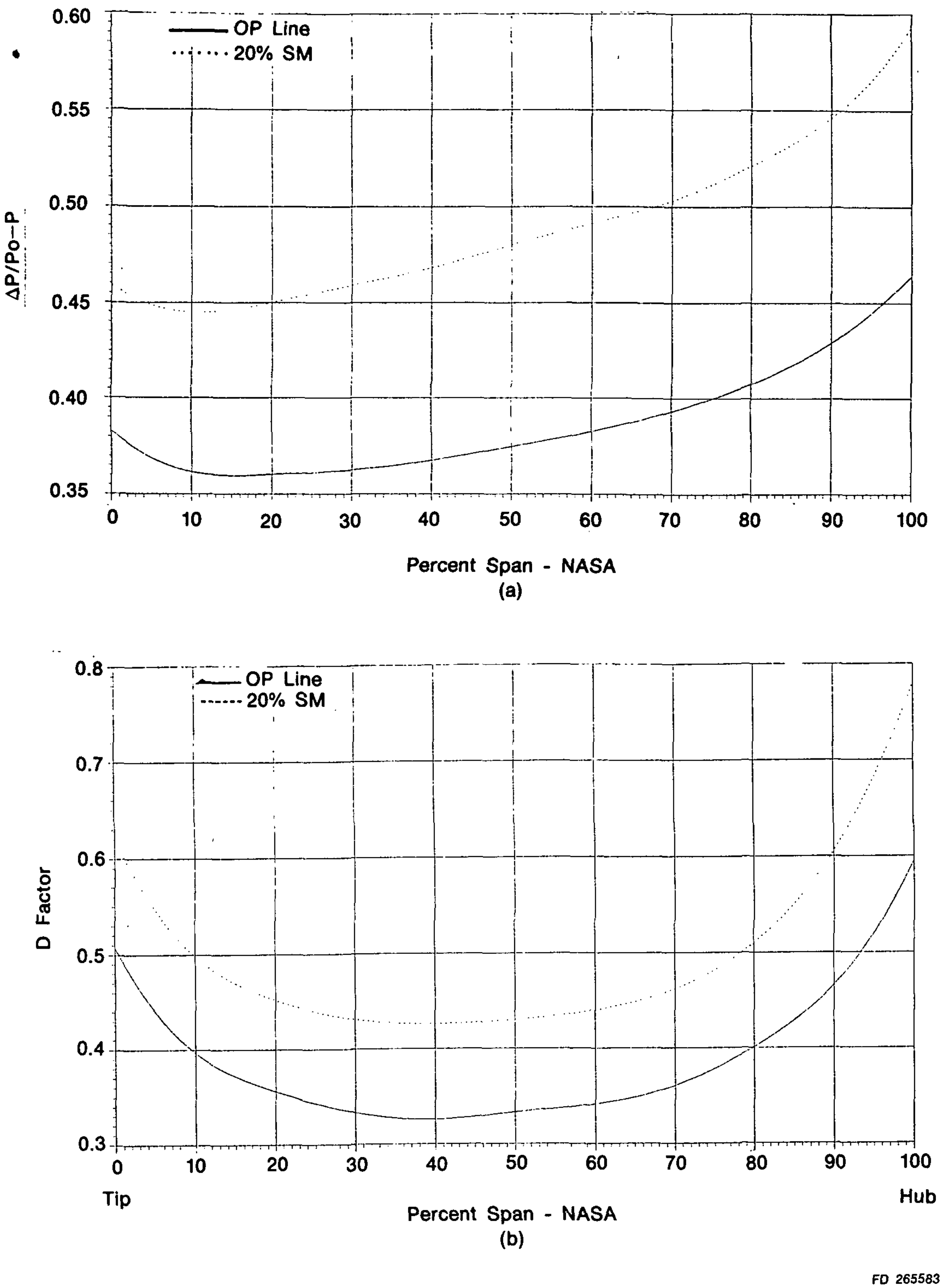

Figure 17. V/STOL Fan Stator Loading ID Stream at Max Control T.O.

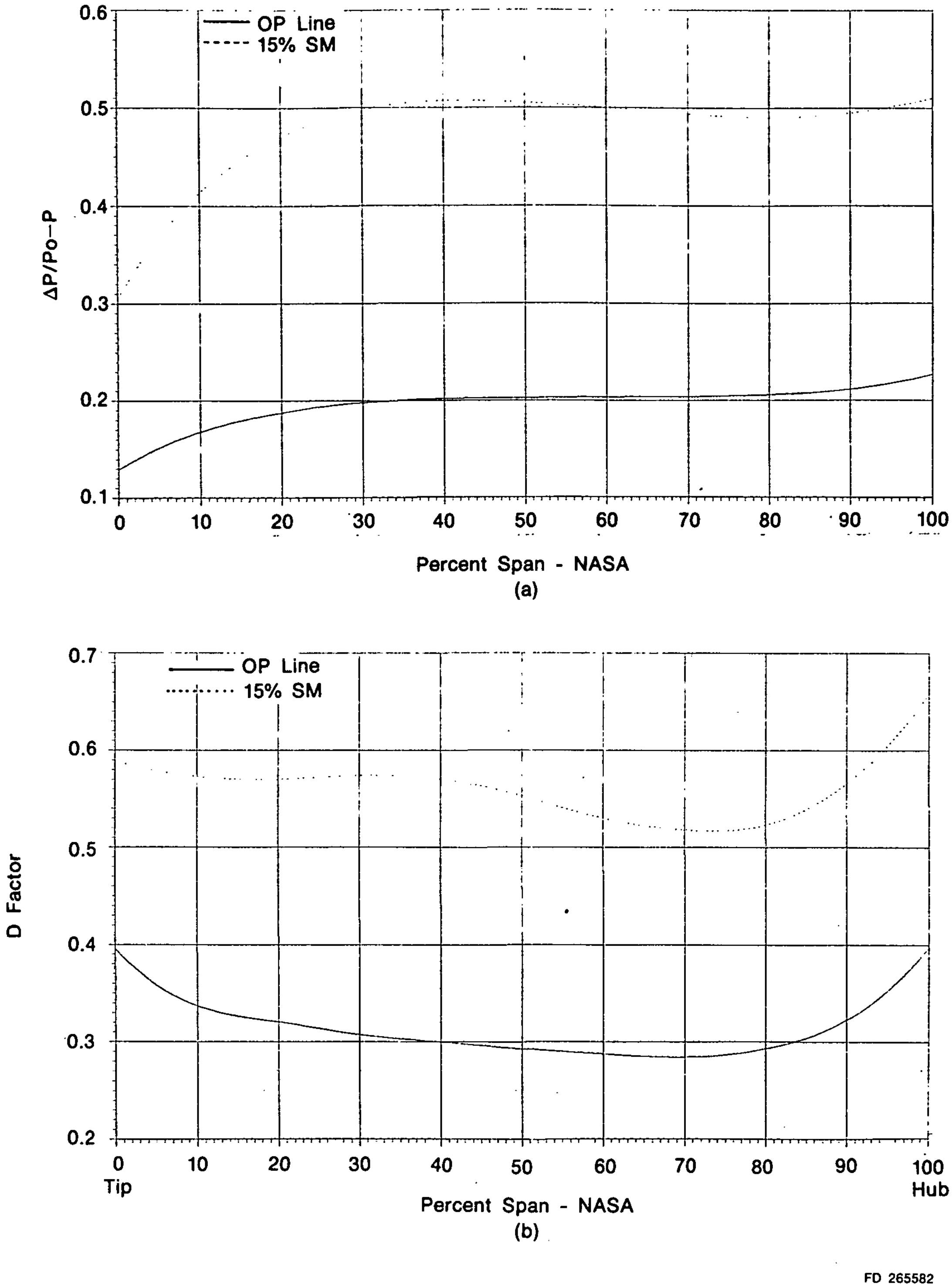

Figure 18. V/STOL Fan Stator Loading OD Stream at Max Control T.O.

TABLE 4. — V/STOL FAN — PREDICTED PERFORMANCE

	Overall		ID		OD	
	Max Flow	*Nom SLTO*	*Max Flow*	*Nom SLTO*	*Max Flow*	*Nom SLTO*
$N_I/\sqrt{\theta}$ ~ *rpm*	17,762	17,762	17,762	17,762	17,762	17,762
$W\sqrt{\theta}/\delta$ ~ kg/s	37.42	33.50	5.09	4.79	32.33	28.71
P/P	1.680	1.531	1.751	1.591	1.669	1.521
$\eta_{AD} \simeq$ %	79.54	82.98	84.97	84.87	78.68	82.66
BPR	6.35	6.0	—	—	—	—
VIGV	+18°	0°	+18°	0°	+18°	0°
$\alpha 3$	—	—	20°	20°	0°	0°
Blade						
D_F	0.452	0.360	0.468	0.307	0.449	0.369
$D_F)_{max}$	0.605	0.470	0.576	0.465	0.605	0.470
ΔP/Po-P	0.432	0.379	0.586	0.431	0.408	0.370
ΔP/Po-P$)_{max}$	0.686	0.557	0.686	0.440	0.638	0.557
Vane						
D_F	0.323	0.410	0.382	0.385	0.314	0.414
$D_F)_{max}$	0.596	0.530	0.596	0.530	0.397	0.488
ΔP/Po-P	0.220	0.312	0.384	0.391	0.195	0.298
ΔP/Po-P_{max}	0.464	0.407	0.464	0.407	0.227	0.322

VIGV GEOMETRY

The spanwise chord distribution and number of vanes for the VIGV of the model V/STOL fan stage were established in the preliminary design such that the vane provided sufficient solidity to achieve the flow turning capability required for V/STOL operation. Vane loss was estimated from NASA Task II variable camber inlet guide vane blade element data as a function of flap position and Mach number as shown in Reference 3. Vane angles were defined from Reference 4 which details design procedures for selection of airfoil sections for a 63 series airfoil developed specifically for inlet guide vane designs. The VIGV was designed to be in its true airfoil position (nominal flap position) at the nominal takeoff point.

Due to the high specific flow of the fan stage, the VIGV has little choke margin at the maximum flow point. This condition is aggravated by two factors: the presence of the flow splitter through the vane which blocks part of the annulus, and a maximum thickness requirement for the vane in order to pass a connecting rod through the OD flap to independently actuate the ID flap. The choke margin of the final VIGV design is shown in Figure 19 and was achieved by reducing the number of vanes from 18 to 17 and by modifying the ID flowpath to increase annulus area.

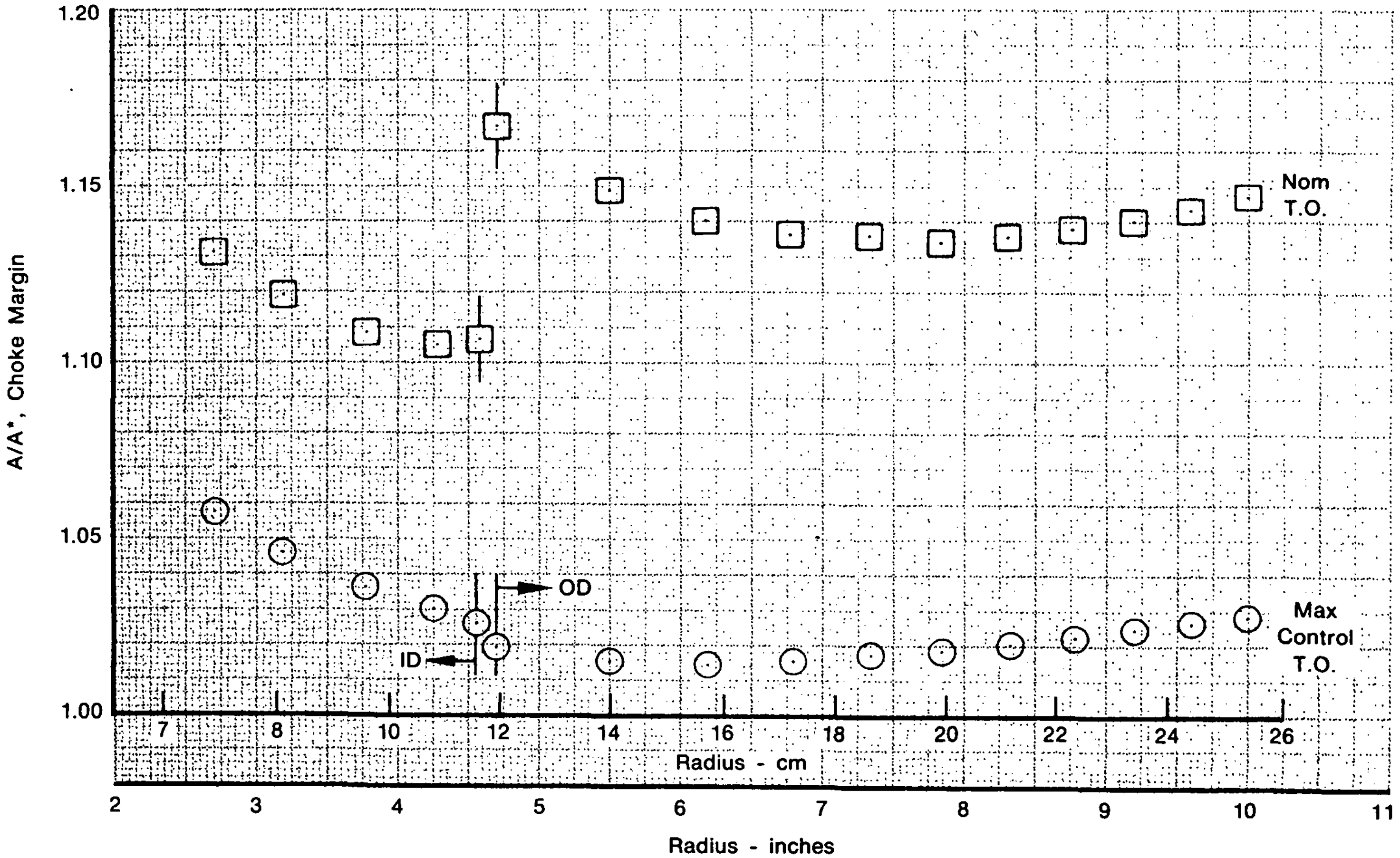

Figure 19. V/STOL Fan VIGV Choke Margin

Variable inlet guide vane minimum loss incidence as a function of flap position was evaluated for a typical section using the Pratt & Whitney Compressor Cascade Prediction system. This prediction system is based on a correlation of standard airfoil series two-dimensional loss and turning data versus typical geometric design parameters such as camber. The cascade system prediction shown in Figure 20 illustrates that the VIGV will be within its loss bucket at any camber corresponding to a flap angle setting to be used in the V/STOL VIGV schedule.

BLADE GEOMETRY

The V/STOL fan blade was designed using the MCA blading program at the maximum control takeoff point where airflow, pressure ratio, and engine thrust are at their maximum values as defined in the design study. Once the maximum airflow point is demonstrated, the nominal takeoff point can be achieved by closing the VIGV to its nominal flap position. The maximum airflow and pressure ratio attained by opening the VIGV flap is achieved at the expense of fan efficiency due to an increase in Mach number and associated losses. However, the maximum control point is only run during transient V/STOL operation where fuel consumption is not a prime concern. Design efficiency will be attained at the nominal takeoff point where the VIGV flap is closed and Mach number losses are reduced.

Figures 21 through 23 display the incidence, deviation, and choke margin studies for the ID section of the blade which controls the core air stream. At the hub where the airfoil sections approximate a circular arc, the cascade prediction system was employed to verify that blade incidence was within the loss bucket. Additional camber was required in the front arc of the blade relative to a circular arc airfoil section to achieve the choke margin displayed in Figure 23.

Figures 24 through 26 display incidence, deviation, and choke margin studies for the OD section of the blade which controls the fan air stream. Incidence and choke margins were set at levels representative of typical fan designs. Deviation values became negative near the OD due to the negative camber employed in the blade as a result of supercharging the core airstream.

STATOR GEOMETRY

Basic stator geometry such as aspect ratio, number of airfoils, and chord was determined in the preliminary design to satisfy the turning requirements of a V/STOL fan without limiting performance. The fan exit guide vane was configured with a variable leading edge flap at mid-chord to control loss and was designed to turn the airflow to the axial direction. The fan ID stator which serves the core air stream was designed as a conventional MCA stator and leaves 20 degrees of swirl in the air stream as representative of preswirl to a high compressor. Incidence into the stators was biased inside the predicted loss bucket at the nominal takeoff point to provide the best incidence compromise into the vanes at the maximum control takeoff point.

Figures 27 and 28 display predicted inlet air angle relative to cascade loss bucket range for the ID stator at the nominal takeoff and maximum control takeoff points (see Figure 93 in Appendix D). Due to the relatively high Mach number at the hub of the ID stator, the loss bucket is insufficiently wide to contain both air angle profiles. Consequently, the ID stator is predicted to be slightly stalled at the hub at the maximum control takeoff point which will result in additional loss and a small efficiency penalty. Since maximum control takeoff is a transient point, the impact of stalled incidence is not expected to affect normal V/STOL operation. Another measure of ID stator incidence, capture-to-throat area ratio, is shown in Figure 29. This ratio is calculated from the MCA blading program and confirms the cascade system prediction that ID stator incidence is within the loss bucket except at the hub at maximum control takeoff. Figure 30 displays suction surface incidence and choke margin for the ID stator at the maximum control and nominal takeoff points. The figure confirms that

sufficient choke margin exists at both points in the stator channel to pass the required flow. Deviation of the ID stator is illustrated in Figure 31 for the two takeoff points.

The stator for the OD air stream, the fan exit guide vane, was designed as a conventional circular arc airfoil due to lower (subsonic) Mach numbers encountered in the fan OD air stream. The fan EGV was designed to turn the airflow to axial and was equipped with a variable leading edge flap to help align vane incidence within its loss bucket. Figure 32 shows EGV inlet air angle relative to cascade loss bucket range for the nominal takeoff point where the vane was designed in its true airfoil position for minimum loss. Figure 33 shows EGV inlet air angle relative to cascade loss bucket range for the maximum control takeoff point if there is no variation of the leading edge flap position. From this figure, it was estimated that the leading edge flap must be opened approximately three degrees to shift the loss bucket boundaries such that the maximum control incidence profile would be contained within the loss bucket. As a result of this figure and other part speed analyses, an OD stator leading edge flap schedule was developed as shown in Figure 34 as a function of VIGV position. The schedule proved to be independent of fan speed and may be ganged with the VIGV schedule for simplified rig operation. Figure 35 shows EGV deviation for maximum control and nominal takeoff points.

Table 5 summarizes V/STOL fan airfoil geometry for the overall or average airfoil as well as for the ID and OD air stream airfoils. Plots displaying airfoil parameter technical drawing (TD) information are contained in Appendix B.

Upon completion of preliminary airfoil definition, a structural evaluation of the blade revealed a first bending mode 2E intersection in the operating speed range that was judged unacceptable for rig operation. The structural evaluation, which is detailed in Section IV, necessitated the inclusion of a part span shroud into the blade design at approximately 60 percent span from the ID. To offset the blockage of the shroud, blade choke margin was increased by increasing the leading edge angle and front camber over a length of 12 shroud thicknesses such that the increase in choke margin offset the channel area blockage of the shroud. The presence of the part span shroud is readily seen in Figures 24, 24a, and 26 which display OD blade incidence and choke margin.

OFF-DESIGN PREDICTIONS

Once maximum control and nominal takeoff design points were established, V/STOL fan stage performance was predicted for off-design speed and VIGV settings by executing the streamline analysis program in its off-design prediction mode. In this mode, rotor and stator loss and exit air angles have been correlated versus incidence such that the streamline program can model fan stage performance as airflow is varied for constant speed and VIGV position. This procedure was used iteratively in the design phase to obtain stall loading estimates for the fan configurations under consideration.

Using this procedure, fan maps were generated for ID (core) and OD (fan) air streams for VIGV settings at 0 and −20 degrees as shown in Figures 36 and 37. The stall line was predicted for these maps by assuming a maximum blade diffusion factor limit of 0.72 based on fan experience at V/STOL blade aspect ratio levels. Included on these maps is a speedline prediction at 100% speed with VIGV equal to +18 degrees in order to model the maximum control takeoff speedline. The predictions from the ID and OD fan maps were mass averaged and combined to obtain an overall fan stage map which is given in Figure 38. Speed versus flow characteristics were obtained from these maps for a typical operating line and are displayed in Figure 39.

2-D TRANSONIC TIME-MARCHING ANALYSIS

To verify the empirical blading criteria used in the MCA blade and vane designs, a two-dimensional time marching analysis was performed on representative blade and vane sections. The time-marching analysis is a potential flow solution to the equations of motion employing artificial viscosity to model the shock system in the blade passage. The analysis requires a definition of the airfoil section, the static pressure ratio across the passage, and the streamtube convergence through the passage. By matching predicted design values for leading and trailing edge air angles, the analysis confirms that the blade passage has sufficient choke margin with the calculated shock system to pass design airflow with the required turning.

Table 6 presents a summary of the calculated time-marching results as compared to design values for selected blade and vane sections. The close agreement between the calculated and design values confirms the blading criteria used for MCA airfoil sections. Figures 40 through 43 display plots of static pressure distribution along a section chord for selected cases.

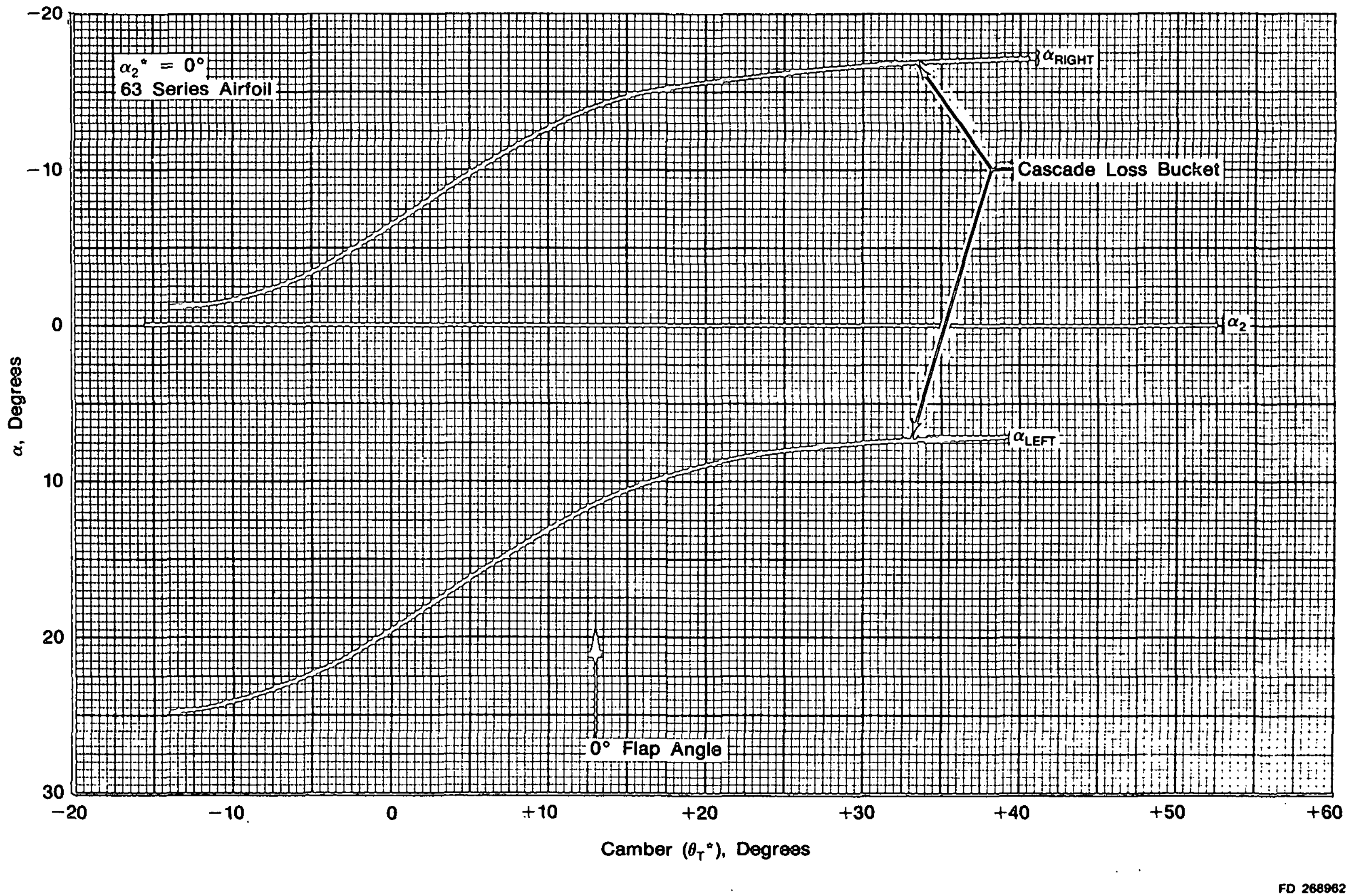

Figure 20. V/STOL Fan VIGV Incidence Tip Section

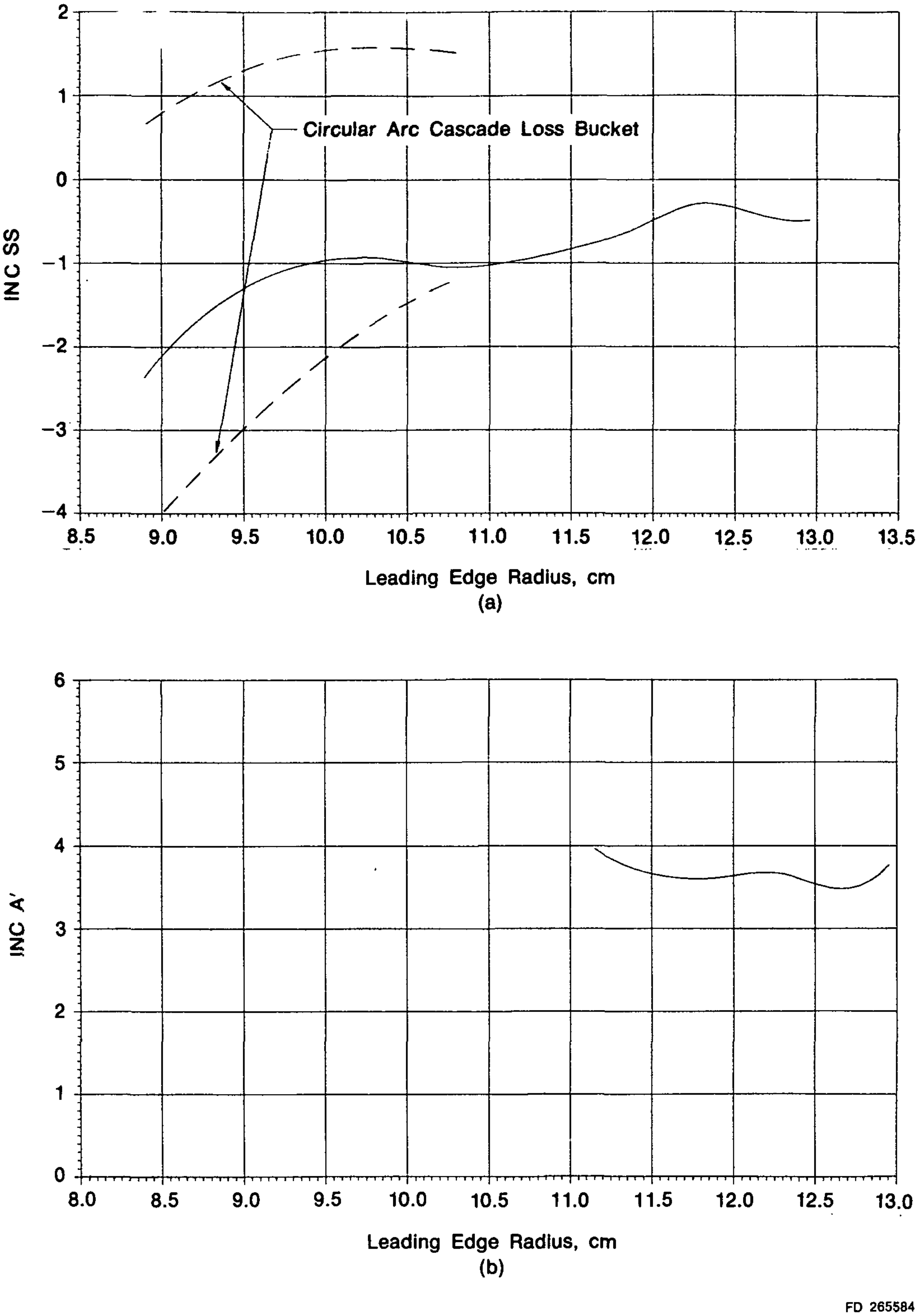

Figure 21. V/STOl Fan Blade Loading — ID Stream Incidence at Max Control T.O.

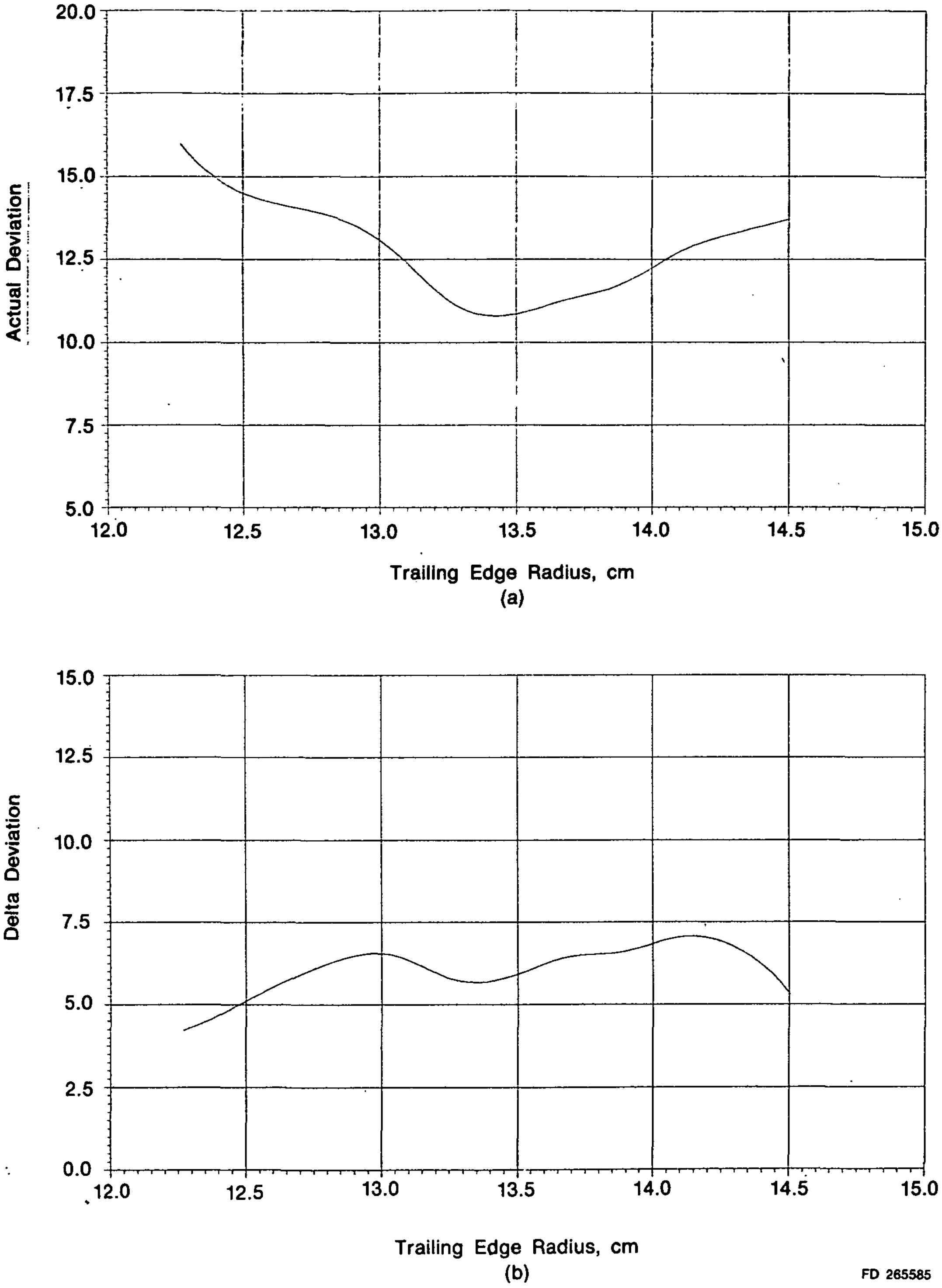

Figure 22. V/STOL Fan Blade Loading — ID Stream Deviation at Max Control T.O.

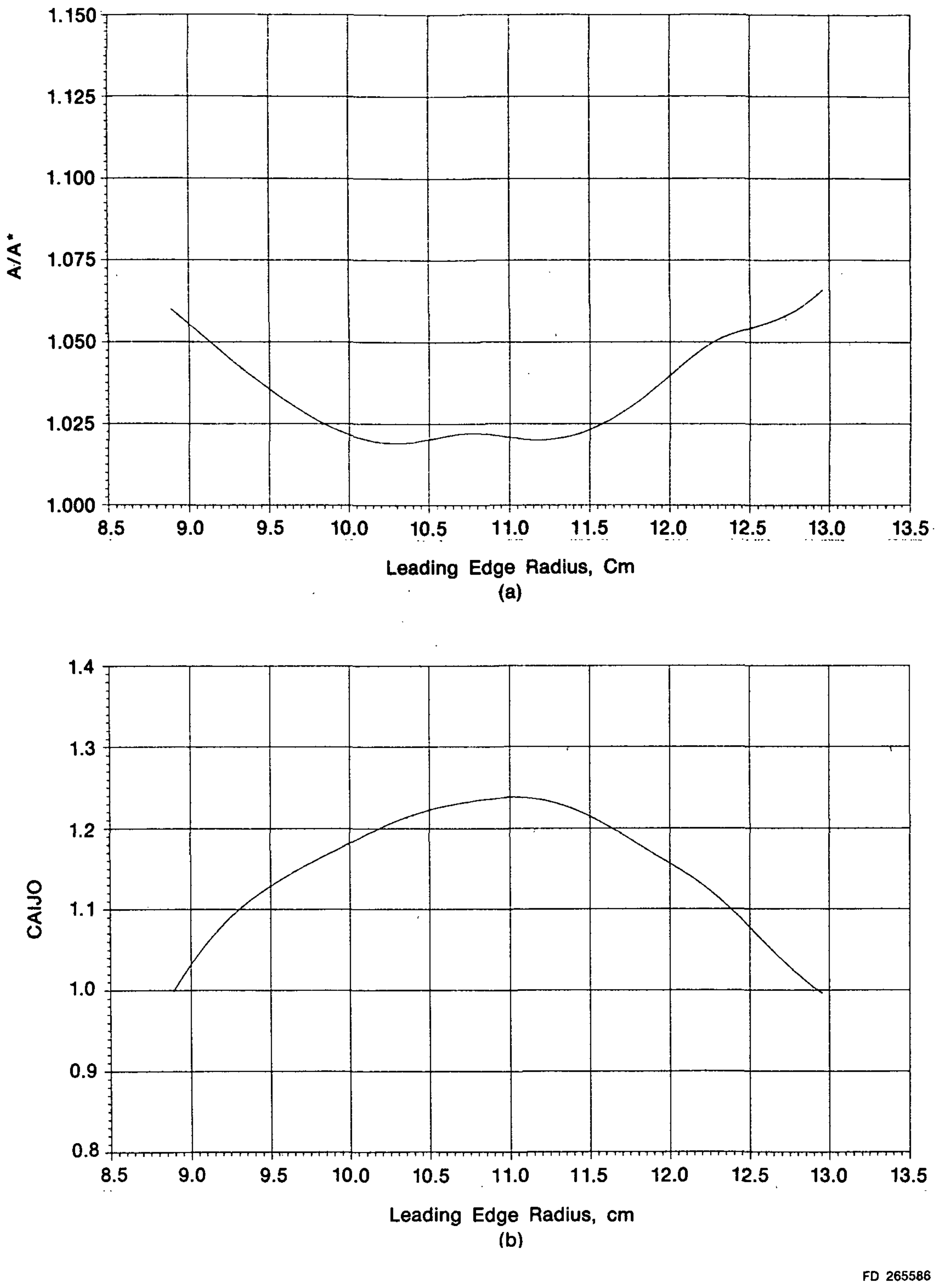

Figure 23. V/STOL Fan Blade — ID Stream Choke Margin at Max Control T.O.

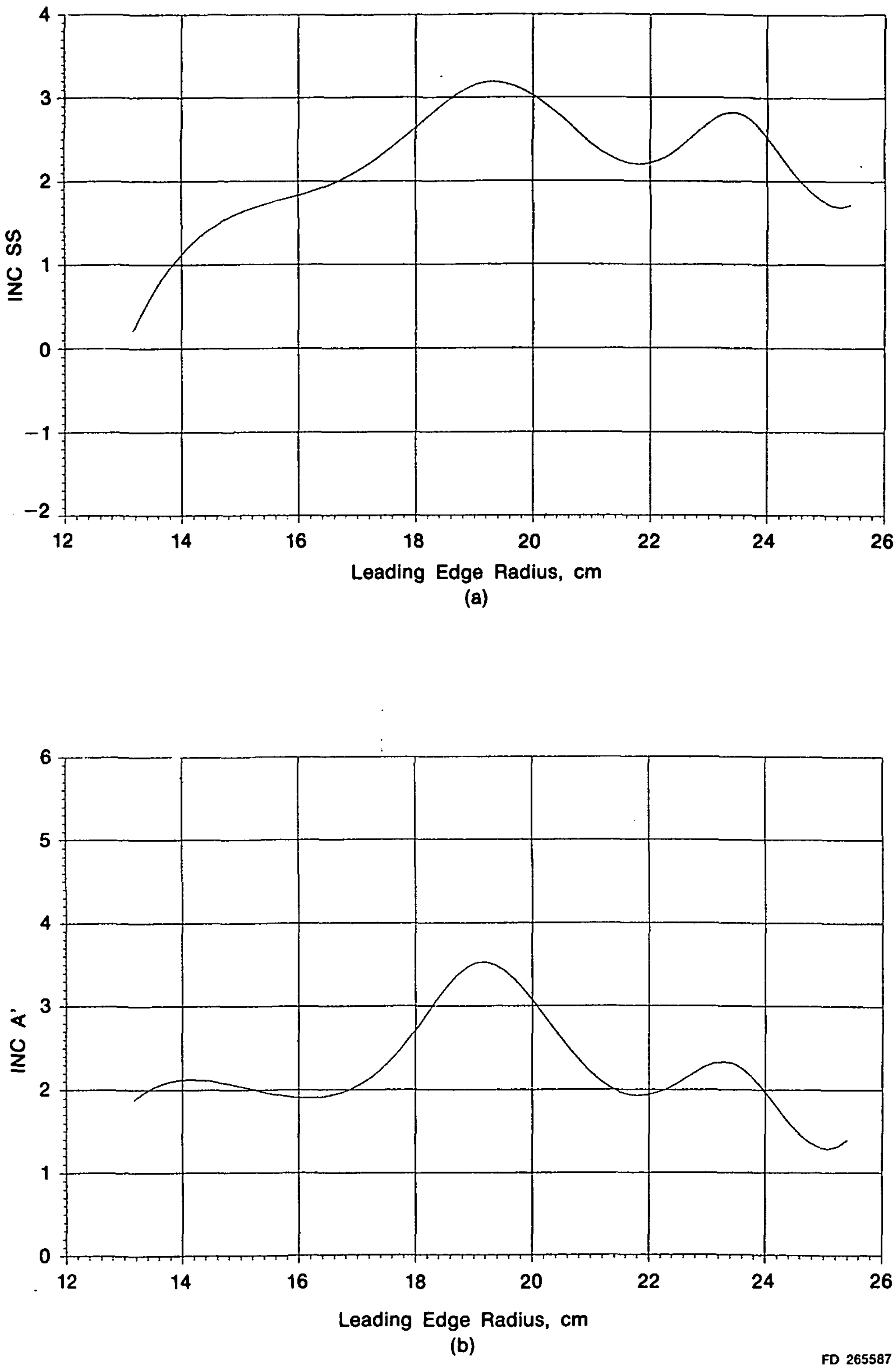

Figure 24. V/STOL Fan Blade — OD Stream Incidence at Max Control T.O.

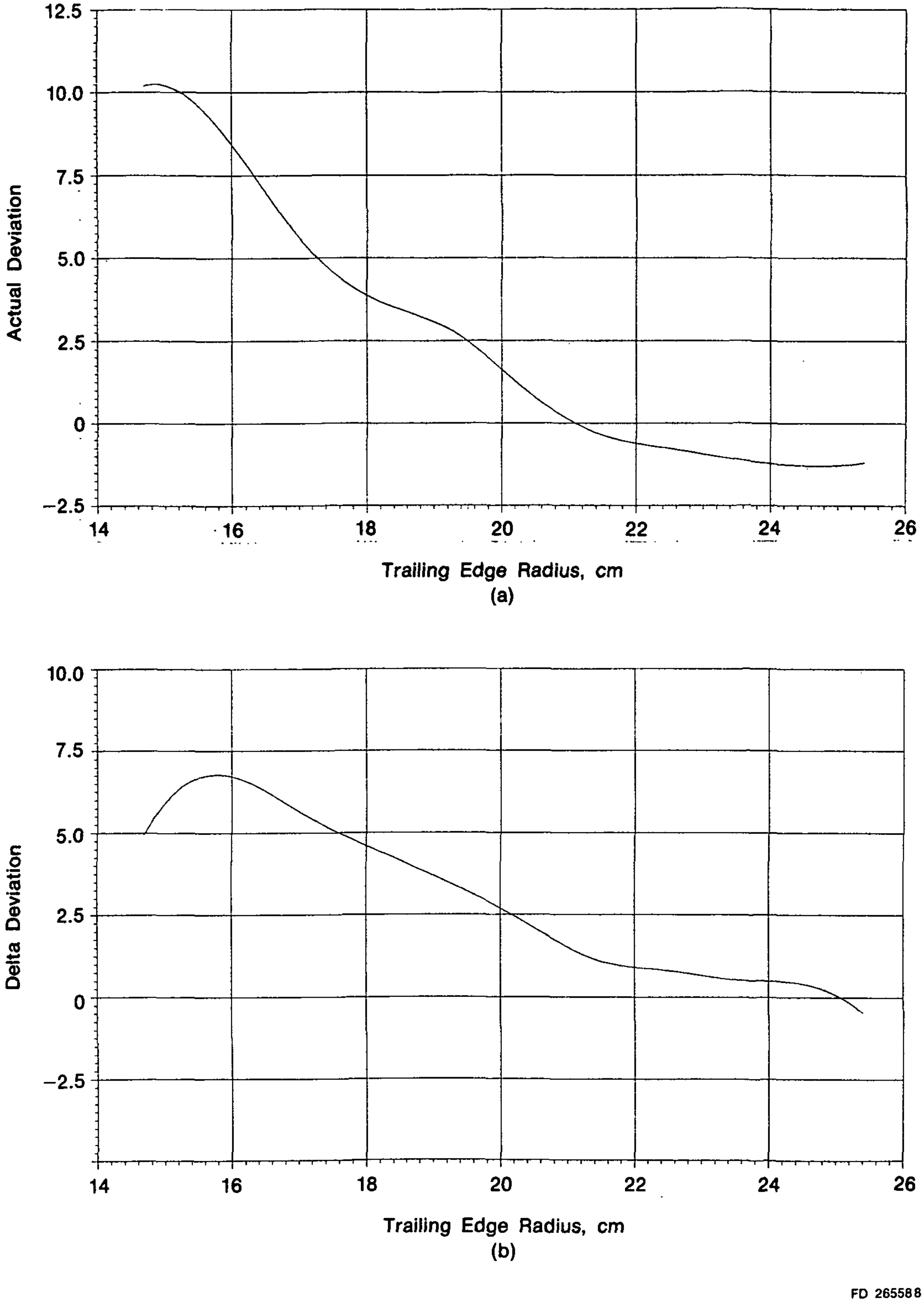

Figure 25. V/STOL Fan Blade — OD Stream Deviation at Max Control T.O.

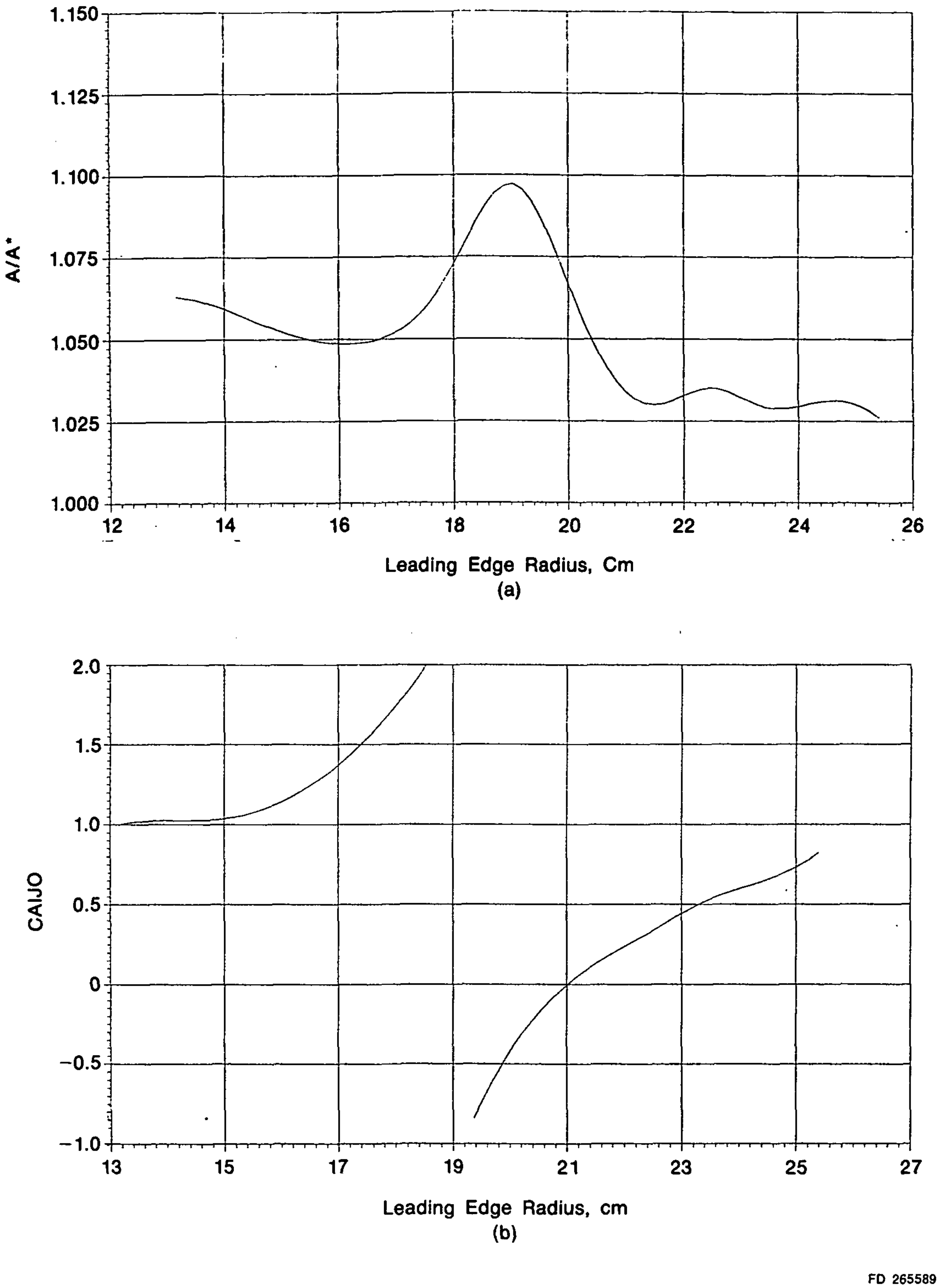

Figure 26. V/STOL Fan Blade — OD Stream Choke Margin at Max Control T.O.

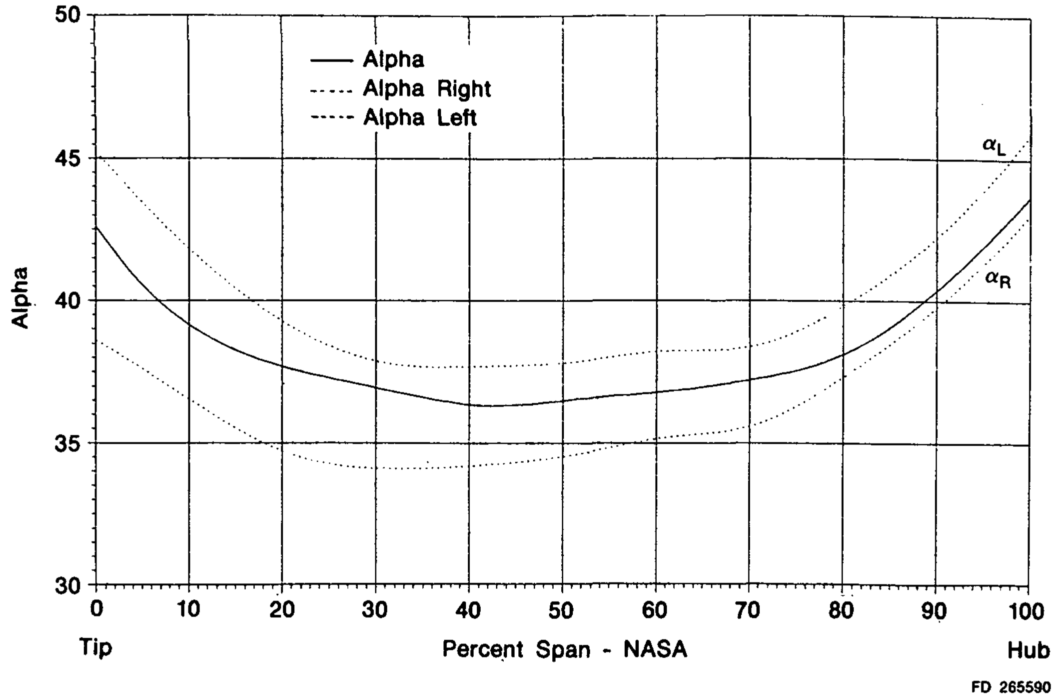

Figure 27. V/STOL Fan — ID Stream Stator Inlet Air Angle Relative to Cascade Loss Bucket Range at Nominal T.O.

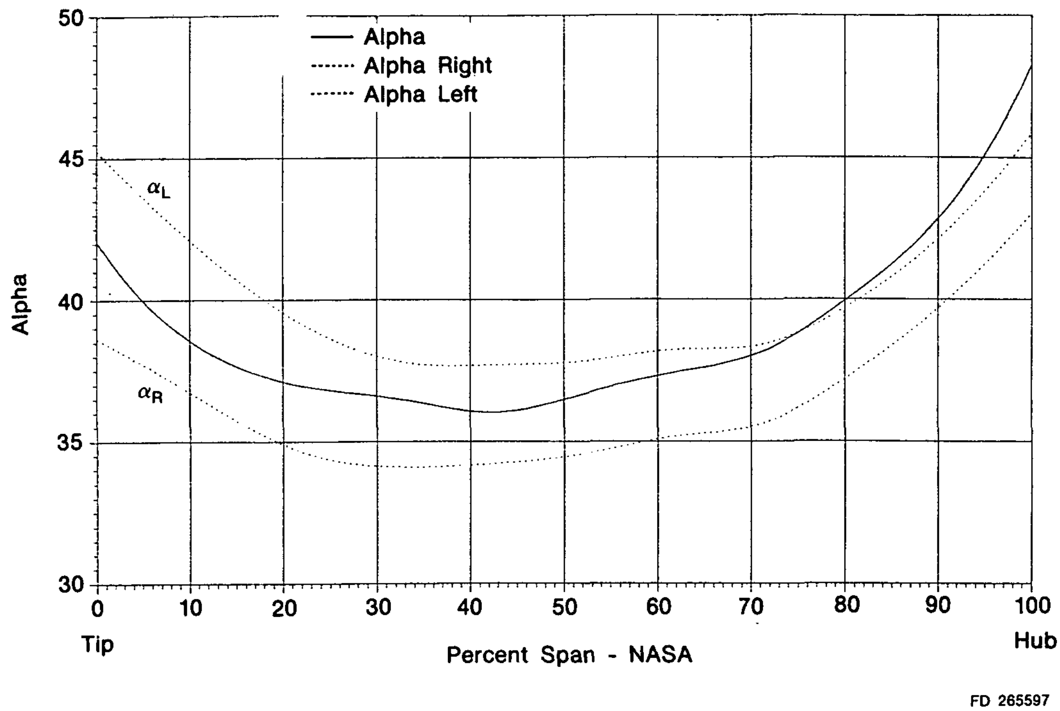

Figure 28. V/STOL — ID Stream Stator Inlet Air Angle Relative to Cascade Loss Bucket Range at Max Control T.O.

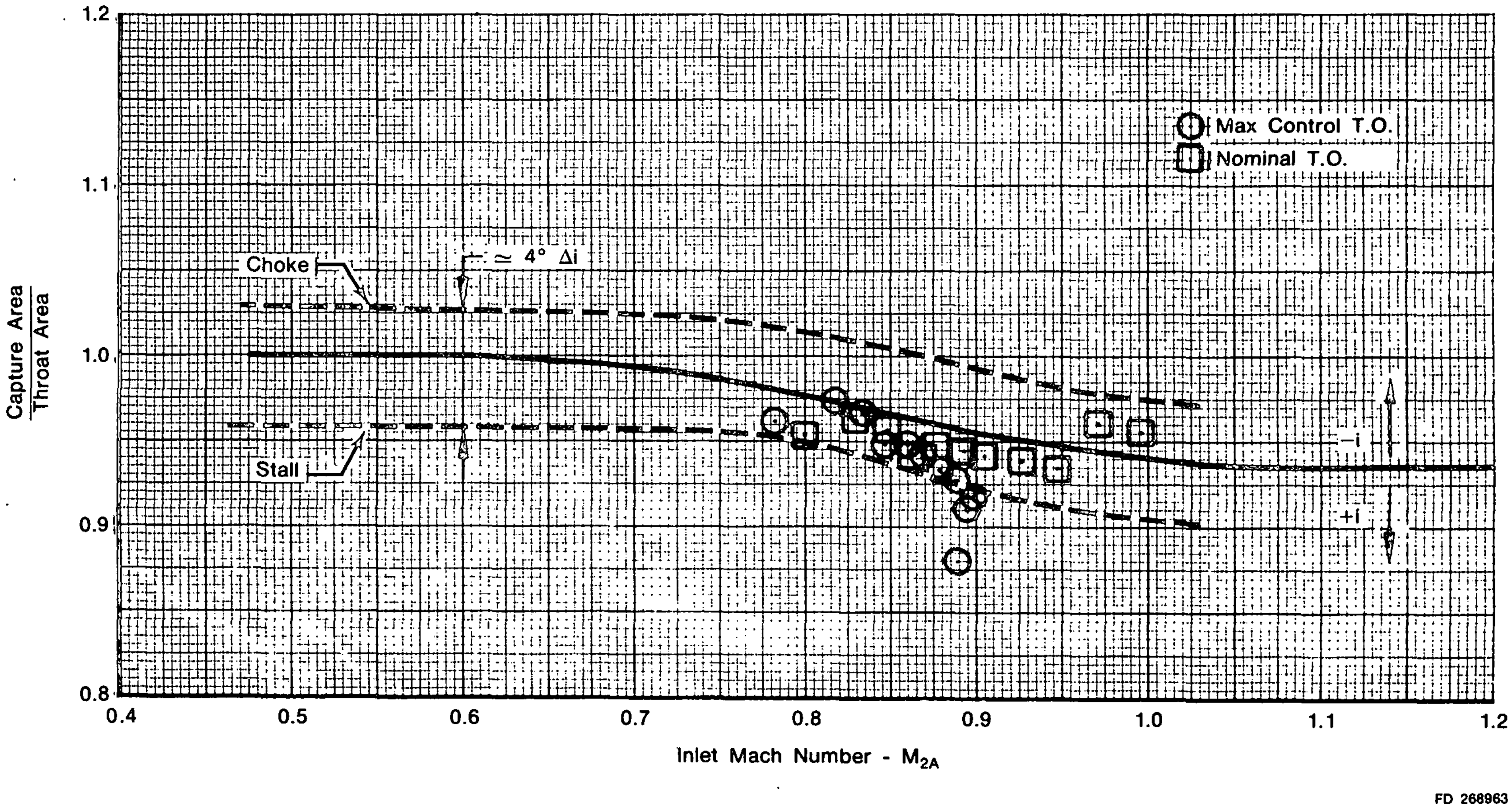

Figure 29. V/STOL Fan — Stator ID Capture/Throat Area vs M_{2A}

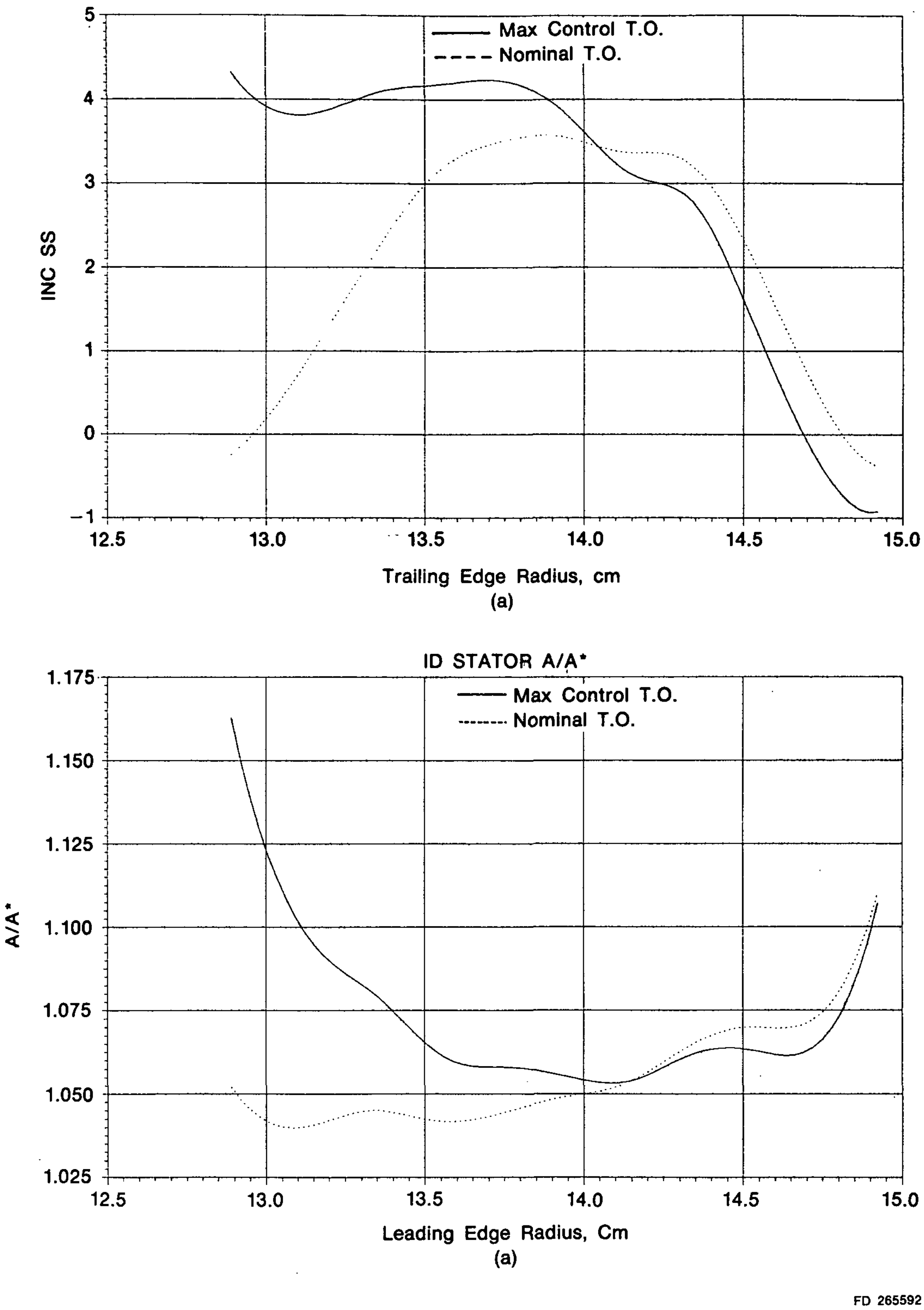

Figure 30. ID Stator Incidence

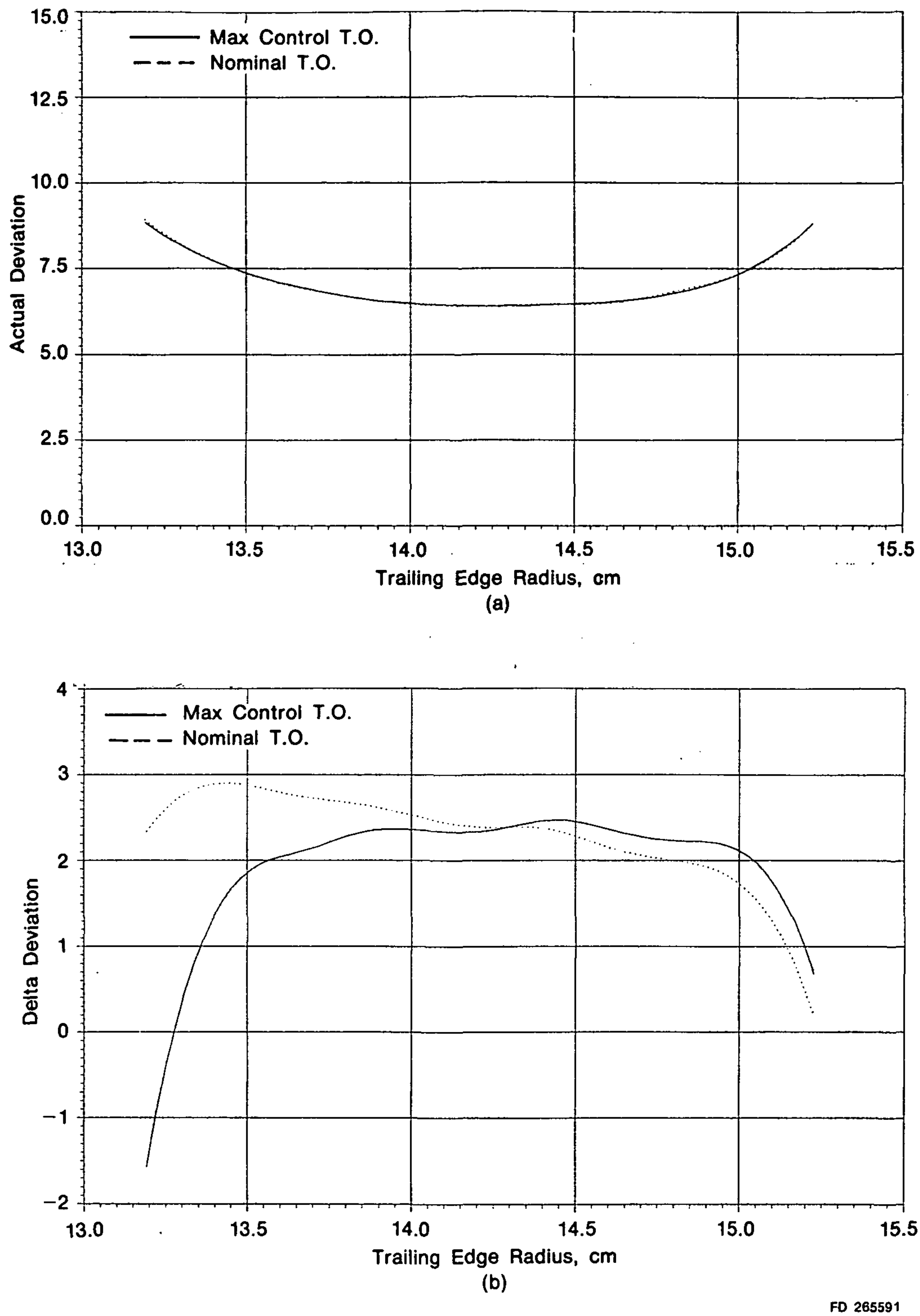

Figure 31. ID Stator Deviation

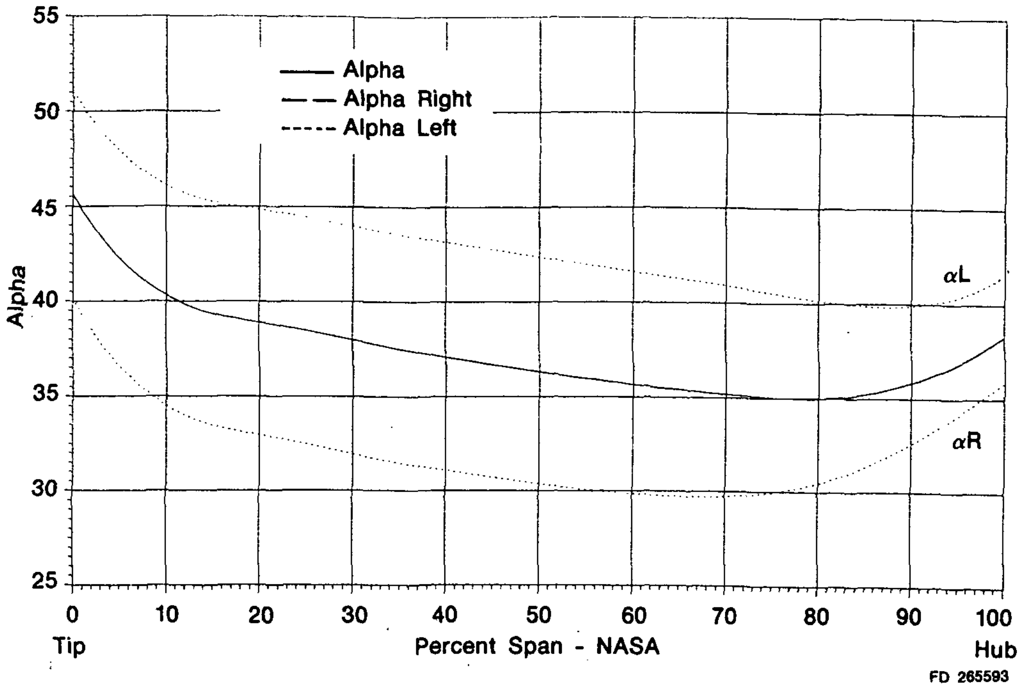

Figure 32. V/STOL — OD Stream Stator Inlet Air Angle Relative to Cascade Loss Bucket Range at Nominal T.O.

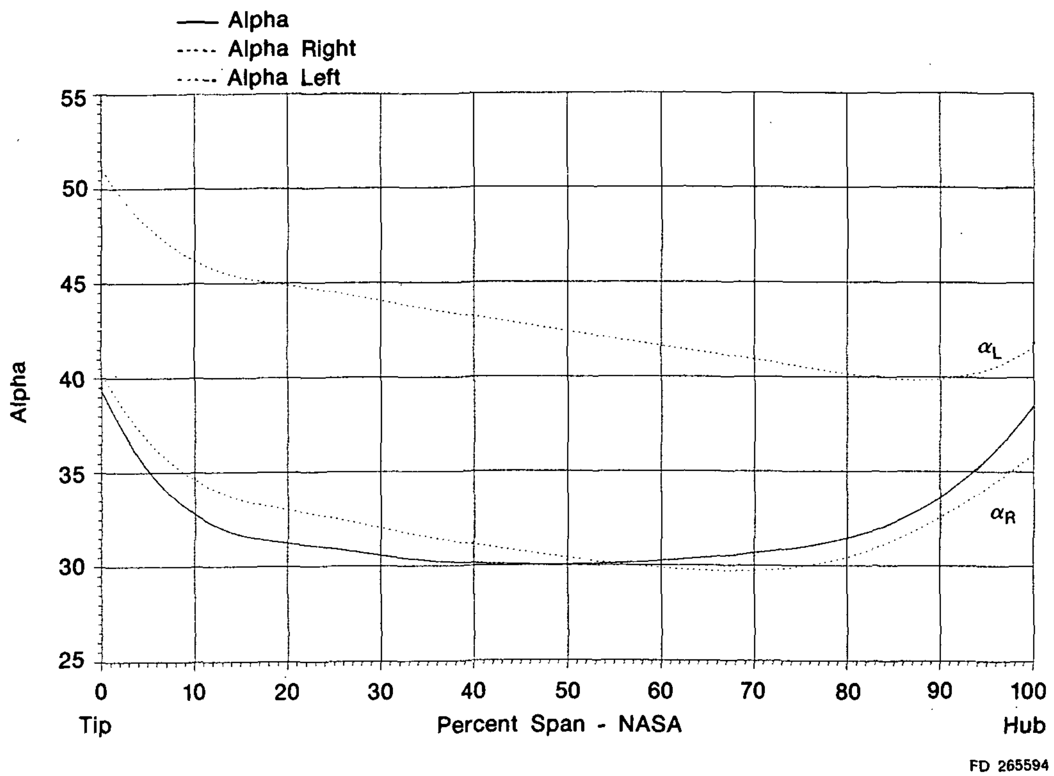

Figure 33. V/STOL — OD Stream Stator Inlet Air Angle Relative to Cascade Loss Bucket Range at Maximum Control T.O.

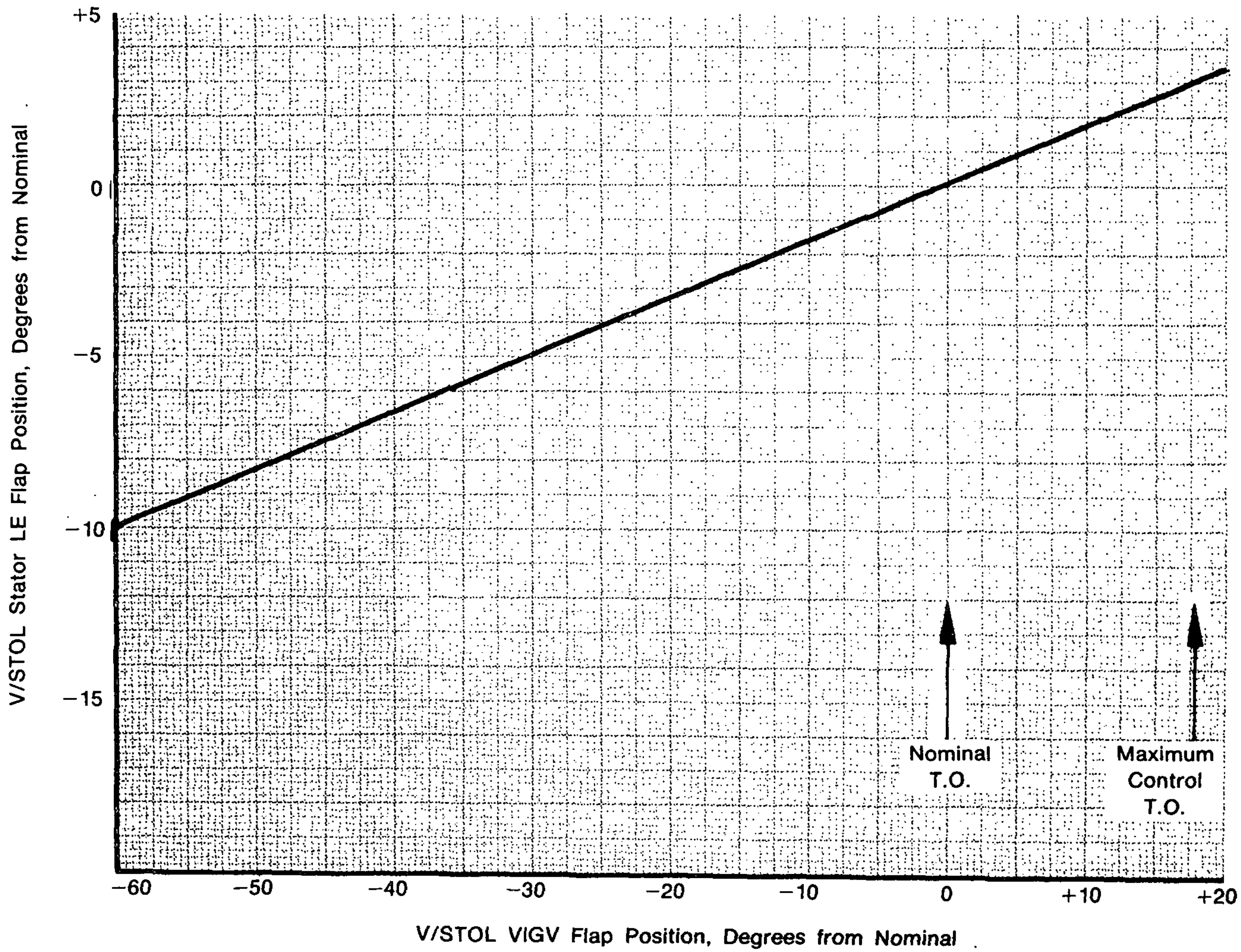

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Figure 34. Stator LE Flap Schedule

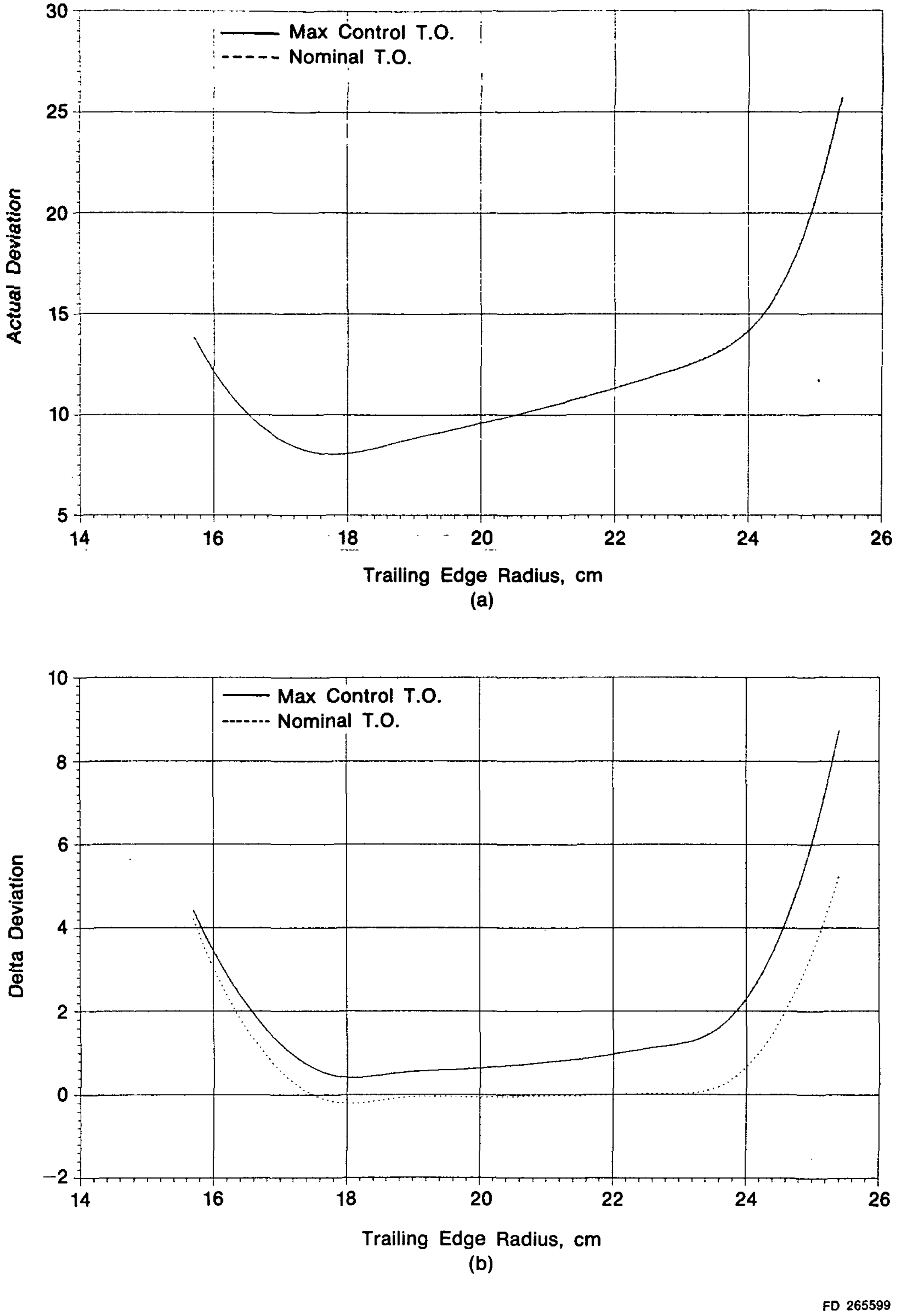

Figure 35. OD Stator Deviation

TABLE 5. — V/STOL FAN AIRFOIL GEOMETRY

	VIGV			*Blade*			*Vane*		
	Overall	*ID*	*OD*	*Overall*	*ID*	*OD*	*Overall*	*ID*	*OD*
Aspect Ratio	1.90	0.83	1.28	1.70	0.40	1.33	2.46	0.40	1.96
Hub-Tip Ratio	0.27	0.59	0.48	0.35	0.69	0.52	0.51	0.87	0.60
Airfoil Series	—	63	63	—	MCA	MCA	—	MCA	CA
Number of Airfoils	—	17	17	—	24	24	—	38	38
Solidity-Root/Tip	1.42	1.87/1.58	1.56/1.35	1.67	2.84/2.16	2.12/1.42	1.52	2.35/2.04	1.99/1.21
Thickness/Chord-Root/Tip	0.081	0.133/0.093	0.113/0.063	0.046	0.075/0.067	0.066/0.030	0.057	0.040/0.045	0.046/0.070
Chord-Root/Tip ~ cm	9.779	4.826/6.858	7.010/12.700	8.458	7.874/7.772	7.772/9.398	5.080	5.080/5.080	5.080/5.080
(in.)	(3.85)	(1.90/2.70)	(2.76/5.00)	(3.33)	(3.10/3.06)	(3.06/3.70)	(2.00)	(2.00/2.00)	(2.00/2.00)
Camber-Root/Tip ~ deg/deg	—	0/0	0.8/13.0	—	61.0/41.5	29.0/−7.0	—	30.6/29.4	58.4/77.6

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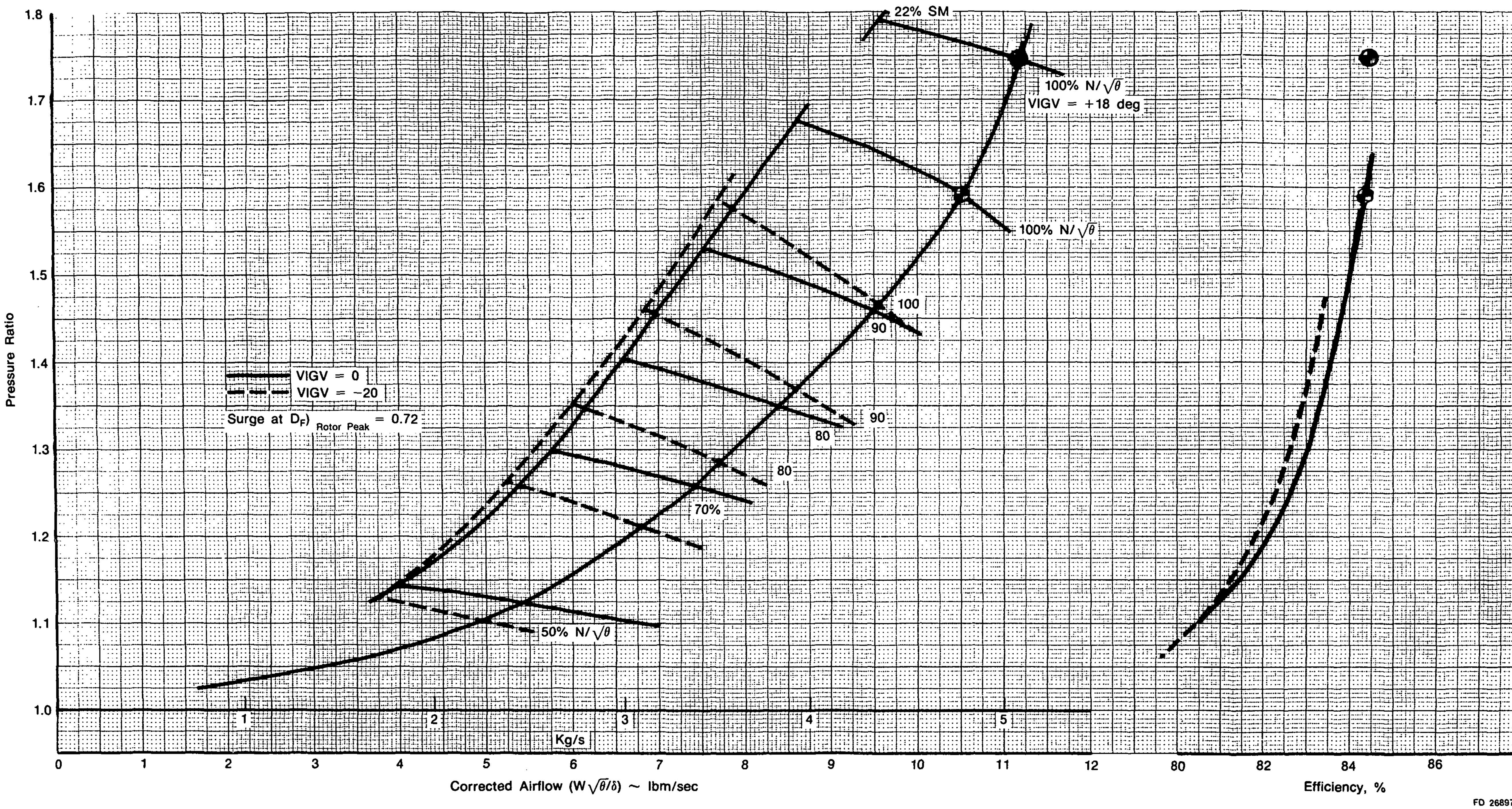

Figure 36. V/STOL Fan Map — ID Stream

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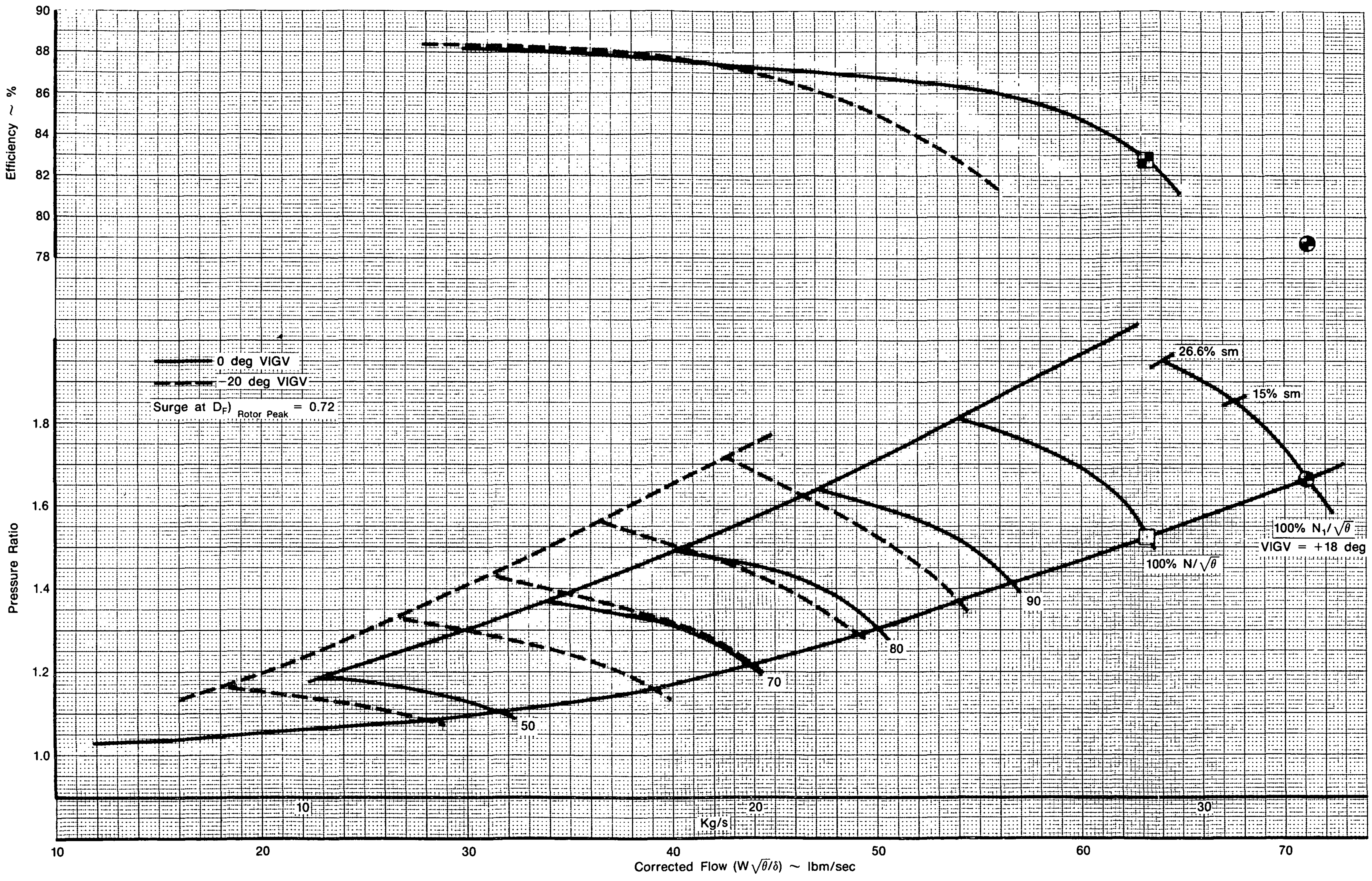

Figure 37. V/STOL Fan Map — OD Stream

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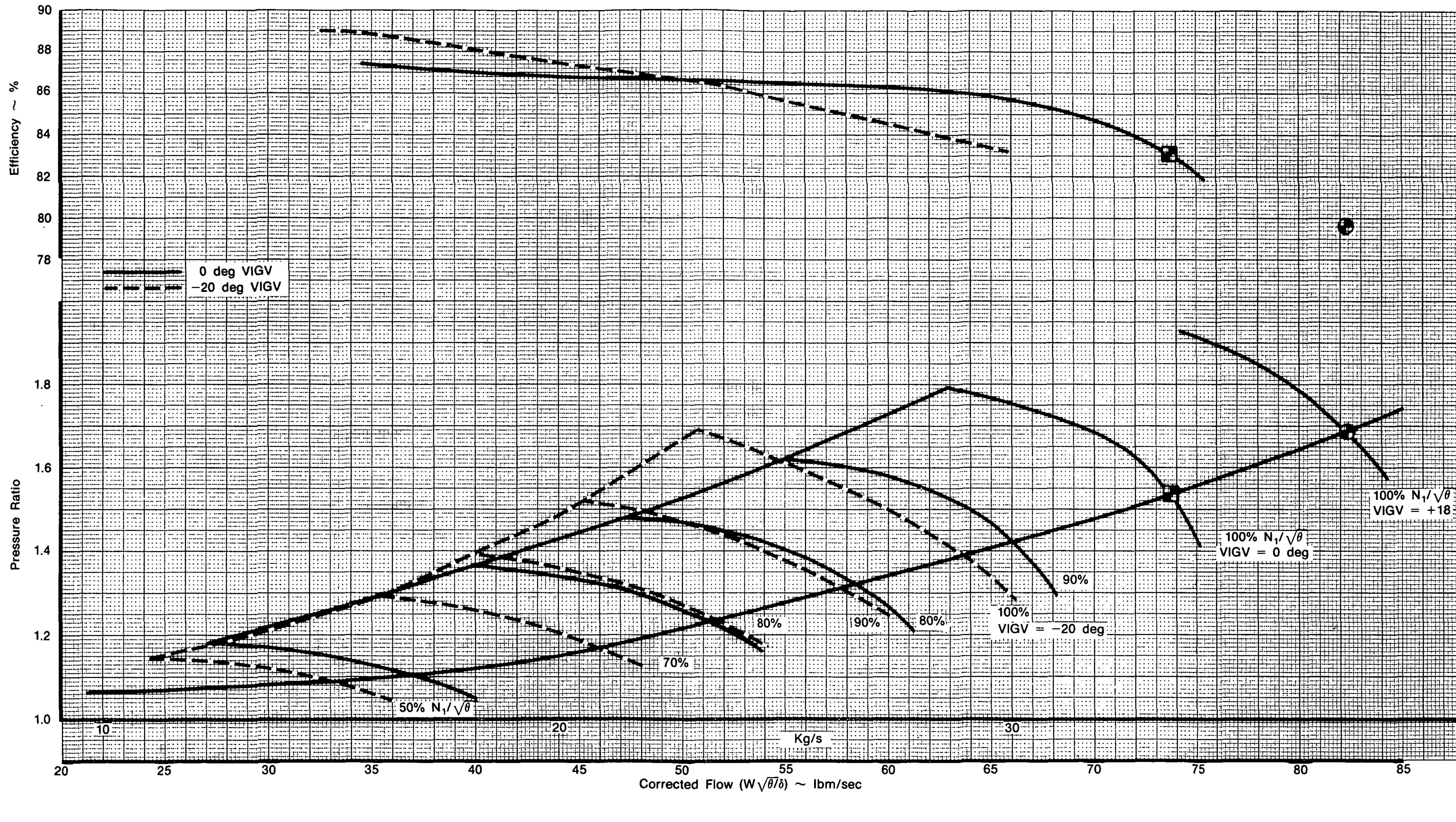

Figure 38. V/STOL Fan Map — Overall

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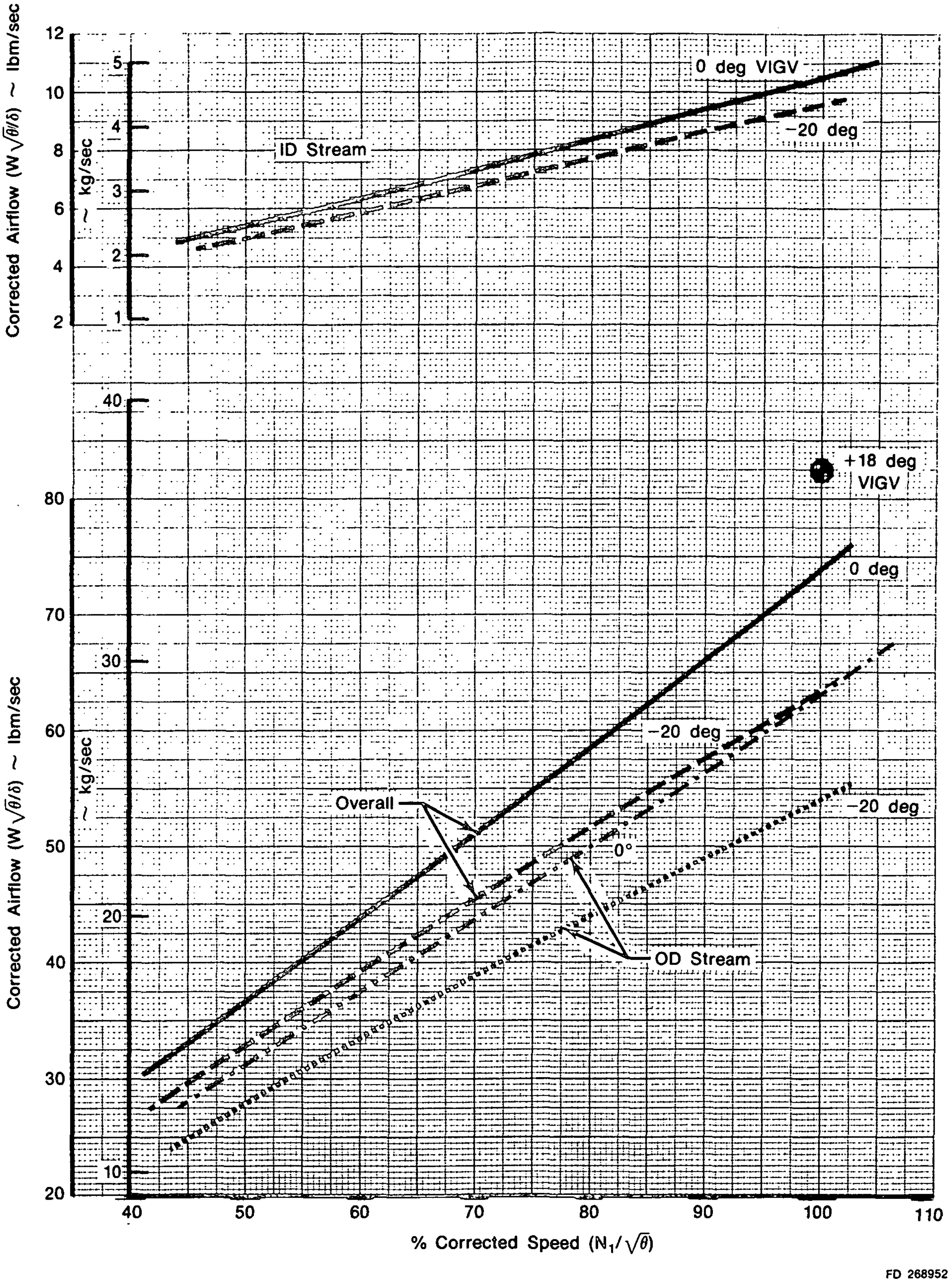

Figure 39. Speed vs Flow

TABLE 6. — V/STOL FAN SUMMARY OF 2-D TRANSONIC ANALYSIS

			Blade Analysis — Max Flow							
			Design Values				*Time Marching Results*			
SL	*No.*	*% Span*	β_1	M_{IR}	β_2	ω	β_1	M_{IR}	β_2	ω
ID	4	35.4	50.1	0.95	11.3	0.047	48.6	0.98	11.3	0.049
	9	83.2	54.3	1.07	20.0	0.109	53.9	1.07	20.6	0.104
OD	2	14.2	52.6	1.30	37.3	0.100	53.7	1.30	37.3	0.100
	4	38.0	56.5	1.43	50.9	0.107	56.5	1.43	51.2	0.107
	6	58.1	59.0	1.53	59.0	0.123	58.8	1.54	59.0	0.128
	10	92.3	63.0	1.69	66.3	0.164	62.9	1.69	65.4	0.164
			Vane Analysis — Nom SLTO							
ID	2	11.9	40.3	0.97	20.0	0.138	48.8	0.95	19.2	0.137
	6	52.6	36.5	0.89	20.0	0.037	53.5	0.89	19.9	0.036
	10	90.2	39.0	0.83	20.0	0.136	50.1	0.81	19.5	0.134

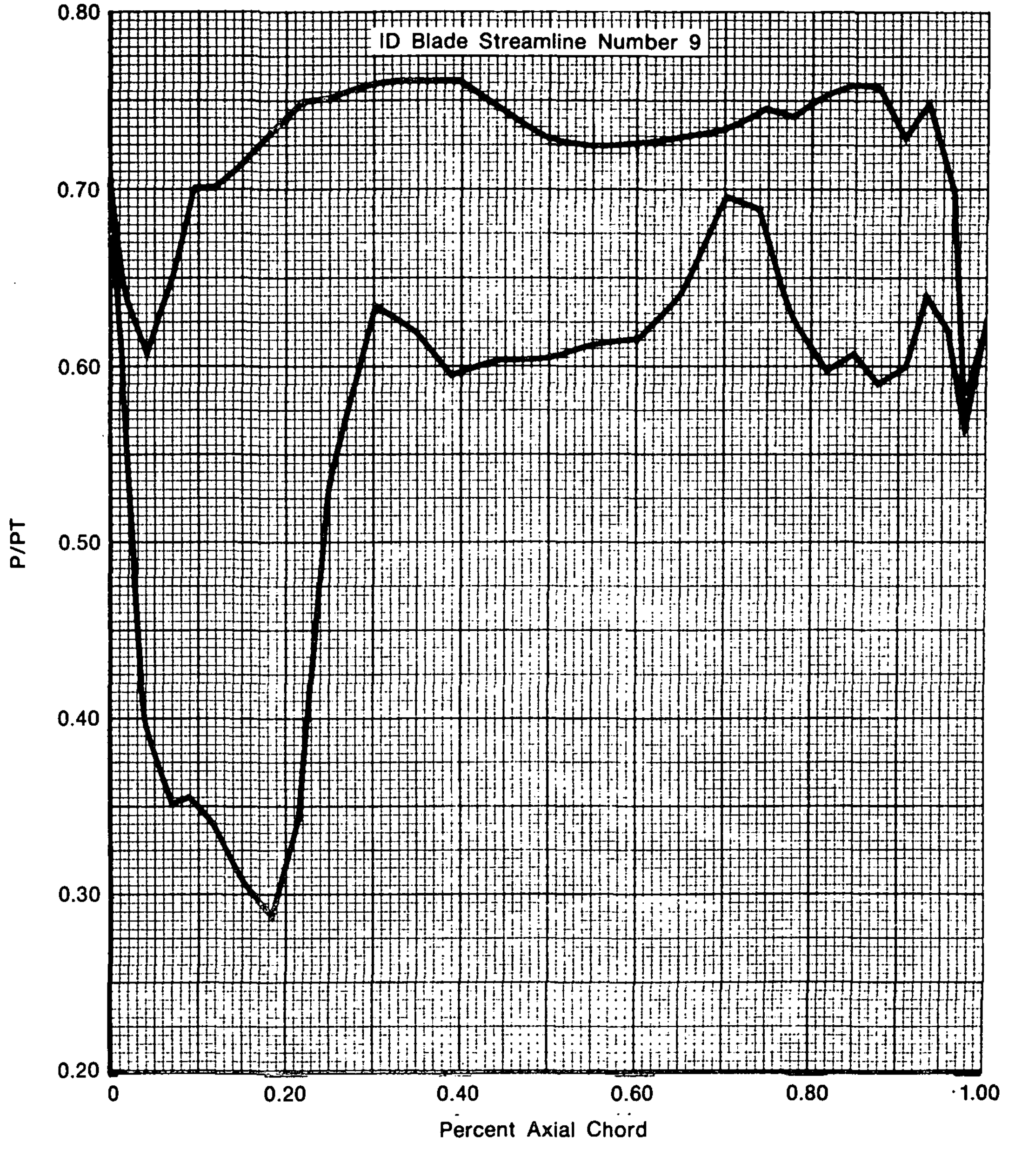

Figure 40. V/STOL Fan Static Pressure Distribution

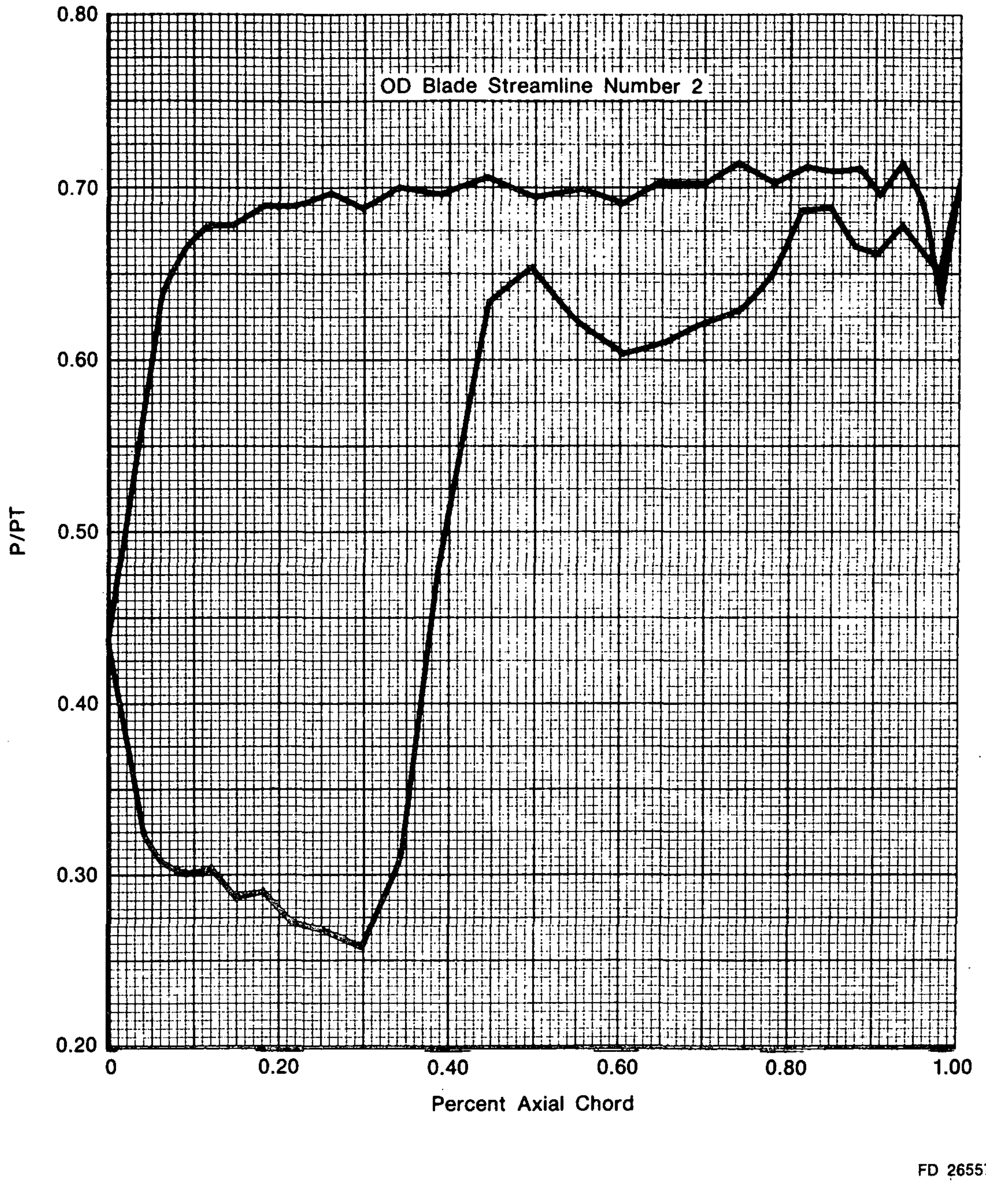

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Figure 41. V/STOL Fan Static Pressure Distribution

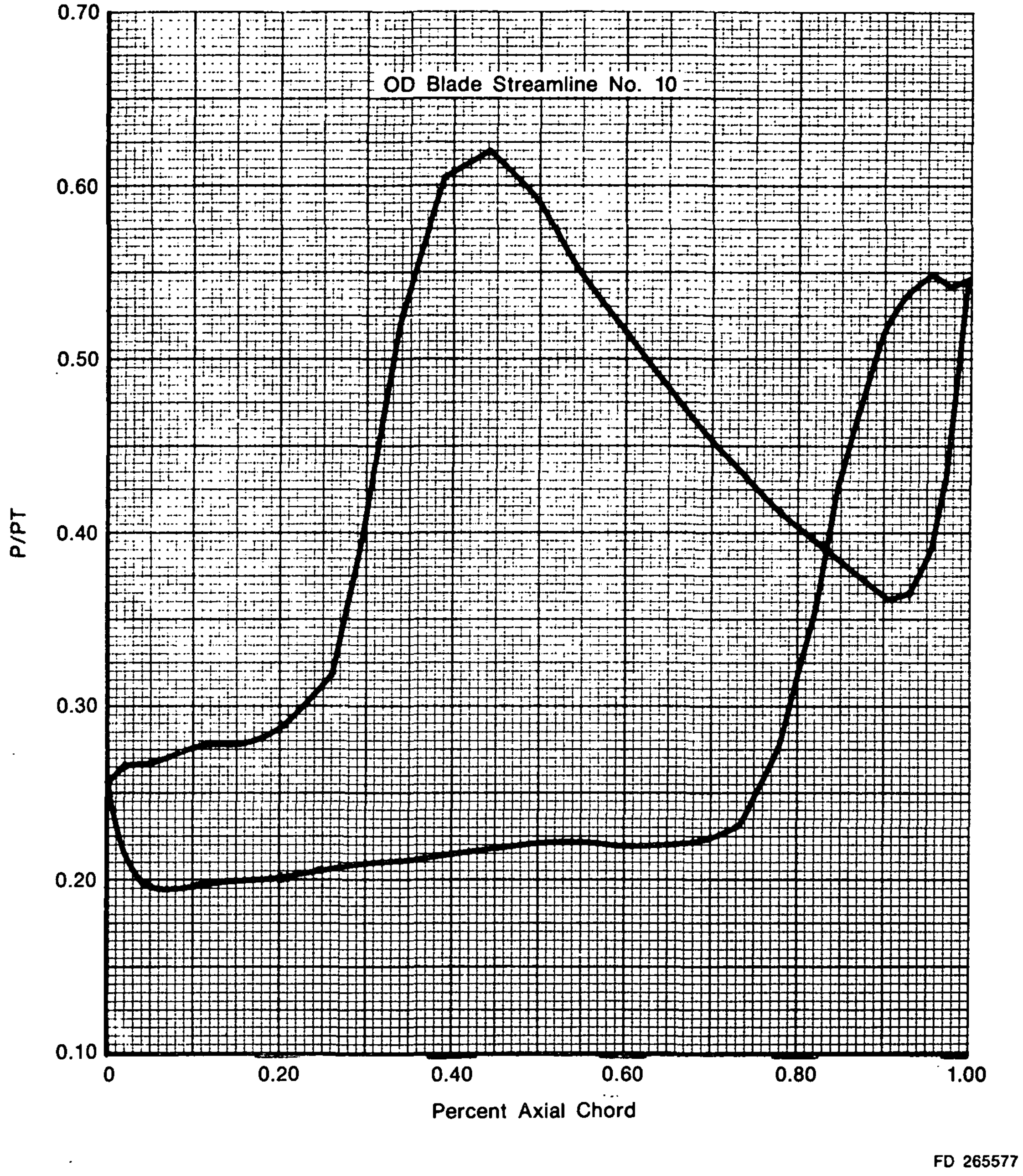


Figure 42. V/STOL Fan Static Pressure Distribution

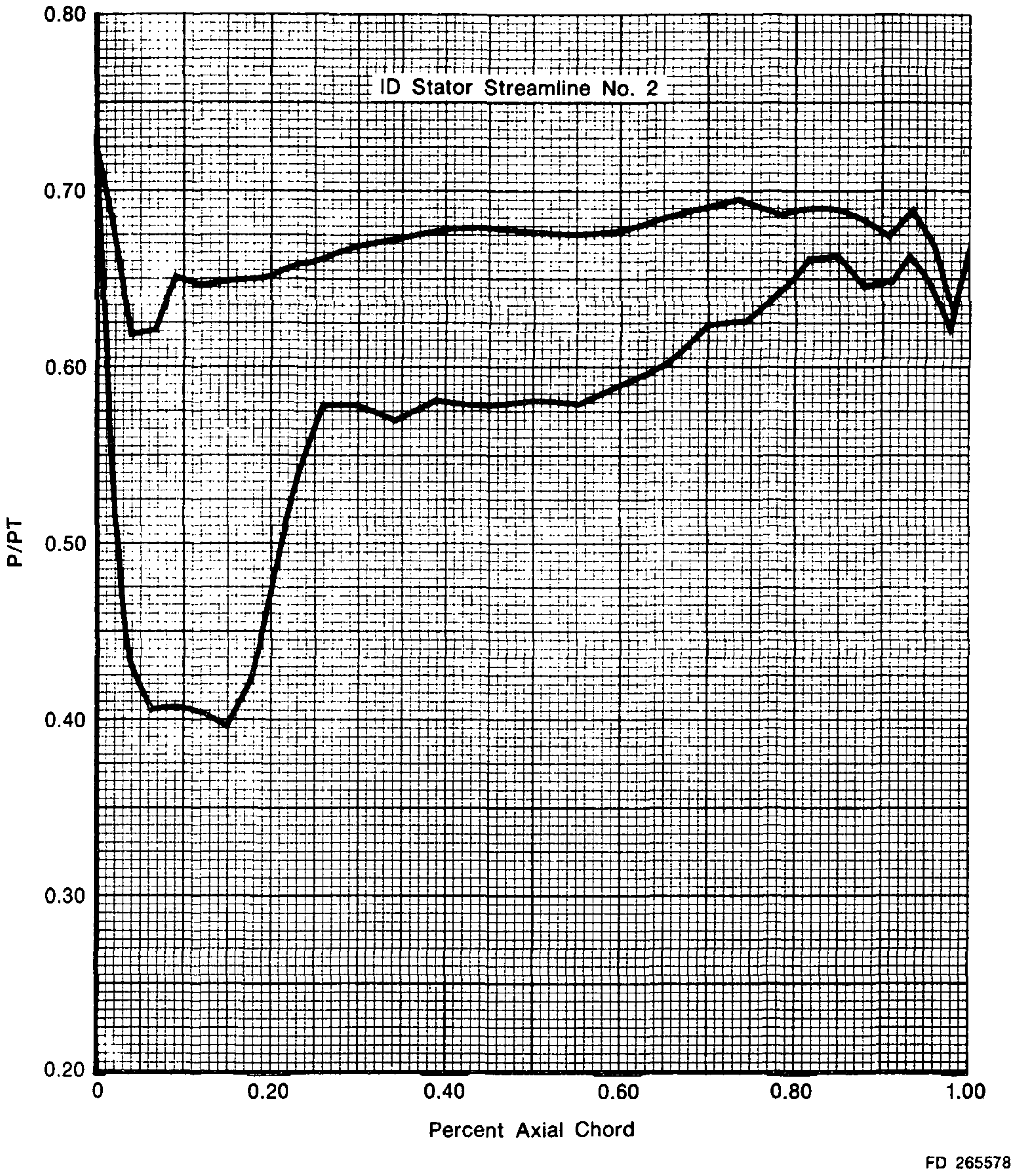


Figure 43. V/STOL Fan Static Pressure Distribution

SECTION V
STRUCTURAL ANALYSIS

The VIBRA/NASTRAN structural analysis conducted to determine the steady stress levels and free vibration characteristics of the preliminary V/STOL fan blade revealed a 1st bending/2E resonance condition at 80% design speed. This condition, involving a known excitation source at a fundamental vibration mode, was considered unacceptable even at part speed. High steady stress loads at the blade root precluded a decrease in thickness to reduce blade frequency and thus drop the 2E resonance below idle. Consequently, an iterative process was initiated to design a part-span shroud that would increase the blade 1st bending frequency sufficiently to obtain a 10% margin above 3E resonance at design speed.

The first iteration series determined the optimum radial location for the shroud. The second series sized the shroud to minimize airflow blockage while maintaining acceptable stress levels in the shroud and airfoil. As a part of this study, the flow path splitter thickness was reduced from 0.457 cm (0.180 in.) to 0.203 cm (0.080 in.) and the blade root thickness increased from 7% to 7.5% to reduce root stress. A third series of iterations was required to locate the shroud as far aft axially on the airfoil as possible. The second and third iteration series were repeated several times since stress levels in the shroud due to blade untwist increased significantly as the shroud was moved aft of the airfoil center of gravity.

As a result of these studies, the optimum shroud and flowpath splitter configurations presented in Table 7 were determined.

TABLE 7. — BLADE SHROUD/SPLITTER CONFIGURATION

Shroud:	Radial Location	=	19.304 cm (7.600 inches) about 50% of fan side airfoil span
	Radial Thickness	=	0.318 cm (0.125 inch)
	Axial Length	=	2.540 cm (1.000 inch)
	Axial Location	=	65% airfoil chord
	First Bending Frequency	=	1011 Hz (14% above 3E)
Splitter:			
	Radial Thickness	=	0.203 cm (0.080 inch — reduced from 0.180 inch)

The resulting structurally acceptable blade as defined in Table 7 necessitated the aerodynamic redesign of both ID and OD flowstream to transform the strucutural requirements into an acceptable aerodynamic design. The addition of the part-span shroud increased blade pull and steady stress at the blade root and added flow blockage to an already high specific flow design. Consequently, adjustments to the flowpath around the splitter were made to provide sufficient annulus area to pass maximum flow in both flowstreams while controlling aerodynamic loading. The redesigned blade featured revised metal angle and thickness definition to accommodate the part-span shroud as well as flow splitter modifications necessary to achieve the aerodynamic goals at the maximum flow condition.

The structural analysis and the flutter/stability margins of this final blade design and the IGV/EGV struts and flaps are presented in the following sections. The inlet guide vane case (AMS 5616) has 17 integrally machined struts with a full ring splitter separating core and fan flows and independently variable core and fan flaps. The rotor (AMS 4973) is an integrally machined bladed disk (blisk) which also incorporates a full ring splitter separating core and duct

flows and a full ring part span shroud. The exit guide vane case (AMS 5616) has 38 integrally machined vane struts with variable leading edge fan flaps and a full ring splitter separating core and fan flows through the discharge.

Blade Analysis Steady Stress

Figure 44 depicts the finite element breakup used to conduct the steady stress analysis for the fan blade. Plate elements were used to model the airfoil, and beam elements were employed to model the integral splitter and part-span shroud. Considerable effort was expended to obtain a geometrically accurate finite element model of the airfoil. The high rate of blade twist and steep flowpath angle for this airfoil caused numerical incompatibilities between the aero geometry preprocessor and VIBRA.

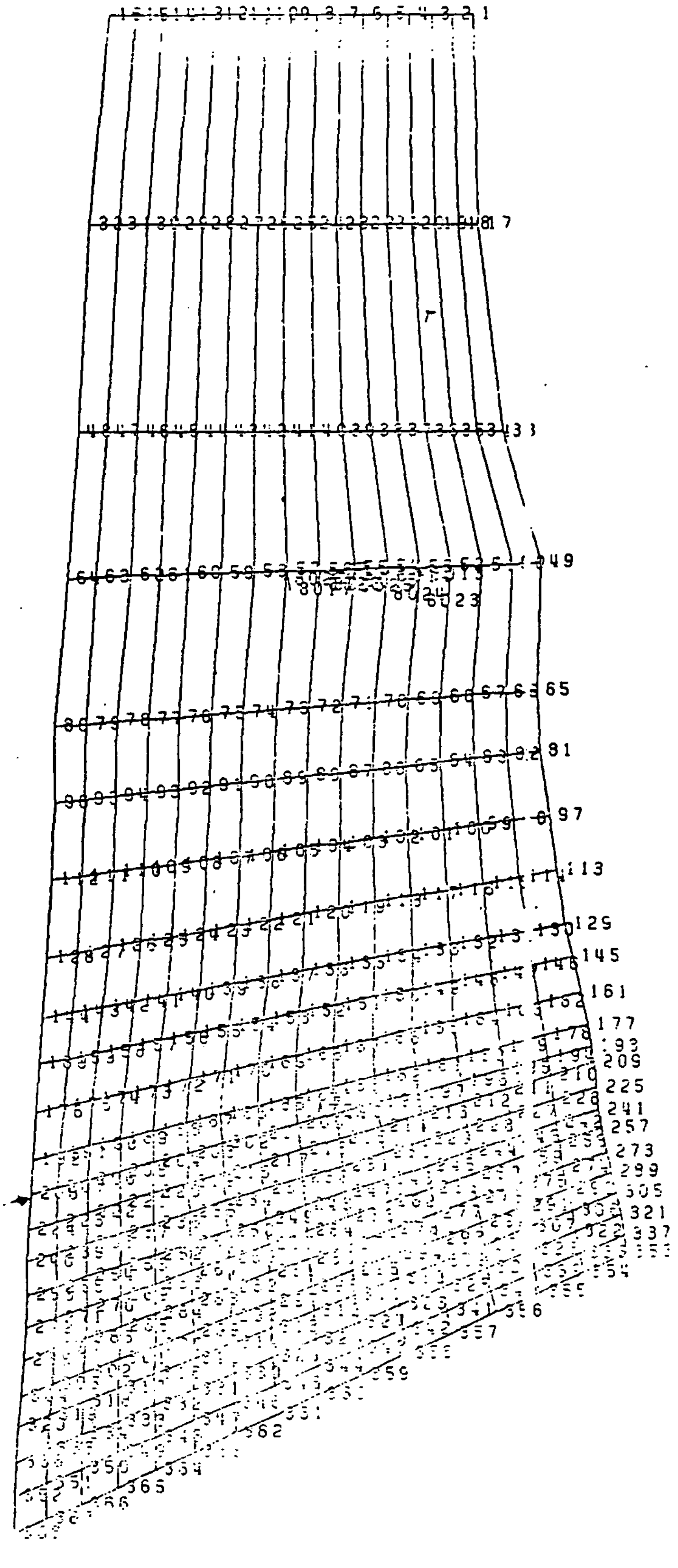
Radial stress contour plots for the airfoil due to inertia loads at maximum rpm are presented in Figures 45 and 46. The plots show that maximum steady stress levels occur at the junction of the airfoil and the flowpath splitter. These high stresses are quite localized and are partially induced by the use of rigid body elements to attach the splitter to the airfoil. Figure 47 depicts the airfoil steady state stress distribution just above the fillet radius runout for the splitter. This plot superimposes the stress levels due to inertial loads from the NASTRAN analysis with the gas bending stresses obtained from the airfoil stress deck and is representative of the predicted maximum stress levels which will be seen in the airfoil. The maximum concentrated airfoil stress (σ nom $\times$ K_t) is 51K Newtons/cm^2 (74K psi) and occurs on the concave surface at approximately 55% chord. This is within the design allowable of 62K Newtons/cm^2 (90K psi) or 75% of 0.2% Y.S.

Stress levels for the flowpath splitter and part span shroud were also obtained from the NASTRAN analysis. Both the splitter and shroud were conservatively modeled as single span beam elements attached to the airfoil with rigid body elements. The splitter and shroud were sized to minimum thickness levels in order to reduce airflow blockage while maintaining combined hoop and bending stresses to acceptable levels. Maximum steady stress levels are predicted to be 58K Newtons/cm^2 (85K psi = 30K psi σ_{hoop} + 55K psi σ_{bend}) for the part span shroud and 41K Newtons/cm^2 (60K psi = 20K psi σ_{hoop} + 40K psi σ_{bend}) for the flowpath splitter.

Although analytical predictions indicate that the blade satisfies the basic design criteria, this unique airfoil configuration requires that the blades be instrumented to monitor and verify these steady stress levels during rig test.

Vibration

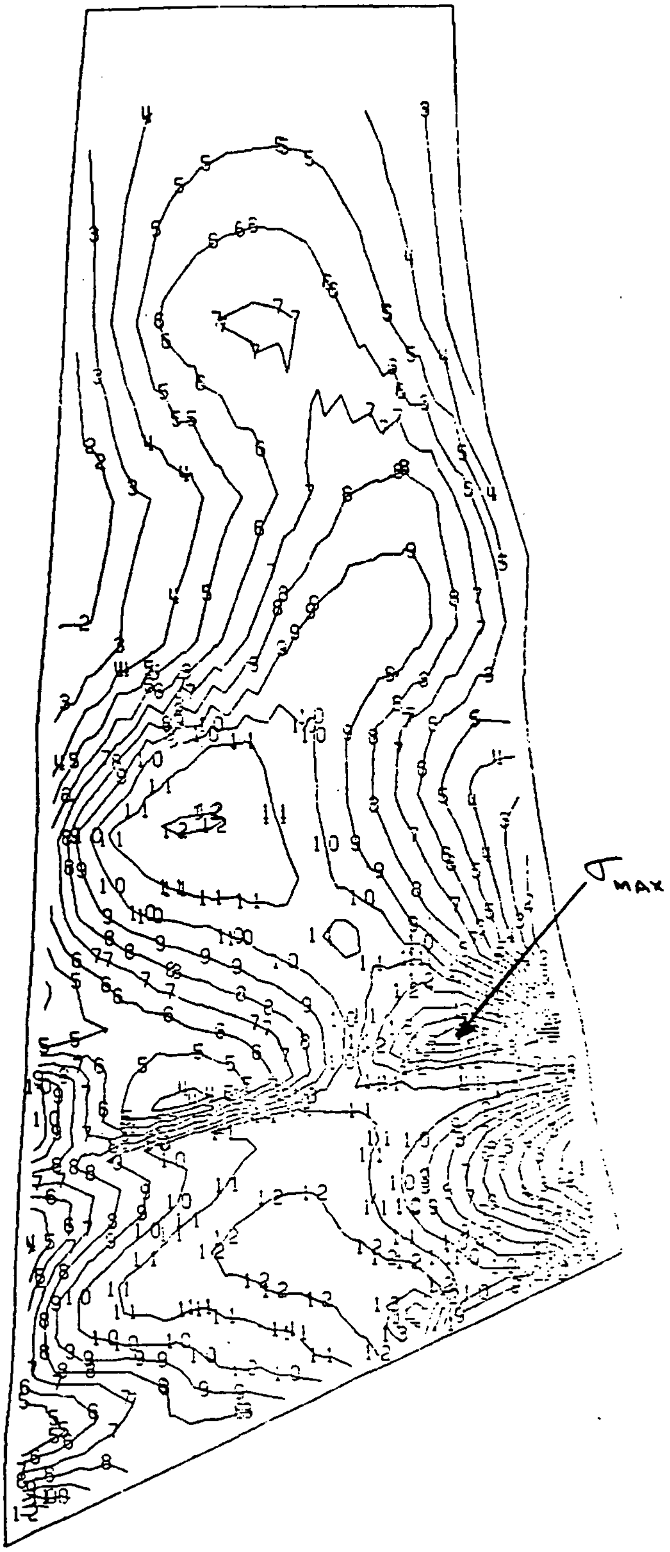
The finite element geometry used for the VIBRA/NASTRAN free vibration analysis of the V/STOL fan blade is shown in Figure 48. The original airfoil design was predicted to have a 1st bending/2E resonance in the high power running range. To eliminate this potentially severe low order resonance, a full ring part span shroud was added to the airfoil at approximately 50% span outboard of the splitter R = 19.431 cm (7.65 in.). With the addition of the shroud, the 1st bending blade alone frequency was increased to 1011 Hz, providing a 14% frequency margin above 3E at maximum operating speed as shown in Figure 49. Figures 50 through 54 are modal displacement plots at 17,762 rpm for the rotor vibratory modes below 17E (17 IGV's).



FD 269051

Figure 44. Blade Steady Stress Finite Element Model

SYMBOL	VALUE (PSI)	SYMBOL	VALUE (PSI)
1	-1.163668E+04	11	5.332524E+04
2	-5.140484E+03	12	5.982143E+04
3	1.355707E+03	13	6.631756E+04
4	7.851898E+03	14	7.281375E+04
5	1.434809E+04	15	7.930994E+04
6	2.084428E+04	16	8.580625E+04
7	2.734047E+04		
8	3.383666E+04		



FD 269052

Figure 45. Blade Radial Stress Contour Plot — Convex Surface

SYMBOL	VALUE (PSI	SYMBOL	VALUE (PSI)
1	-3.674784E+04	11	3.429817E+04
2	-2.964324E+04	12	4.140277E+04
3	-2.253864E+04	13	4.850737E+04
4	-1.543404E+04	14	5.561198E+04
5	-8.329437E+03	15	6.271658E+04
6	-1.224836E+03	16	6.982125E+04
7	5.879766E+03		
8	1.298437E+04		

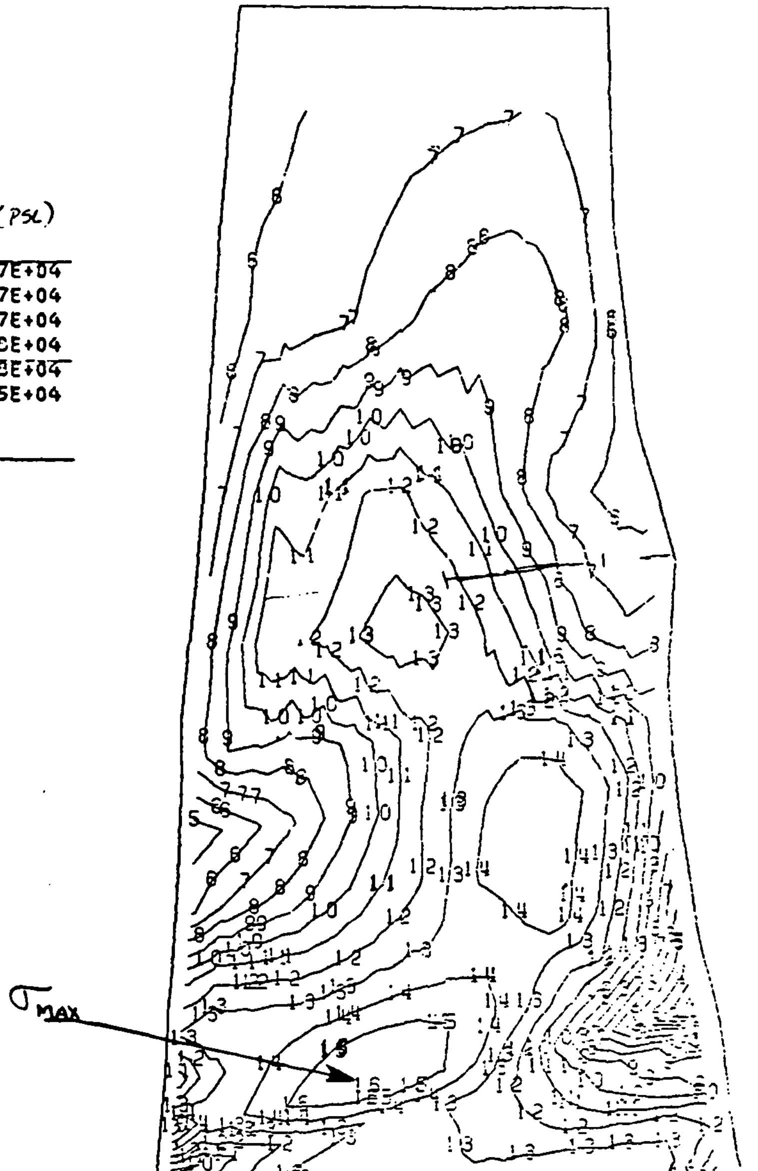


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Figure 46. Blade Radial Stress Contour Plot — Concave Surface

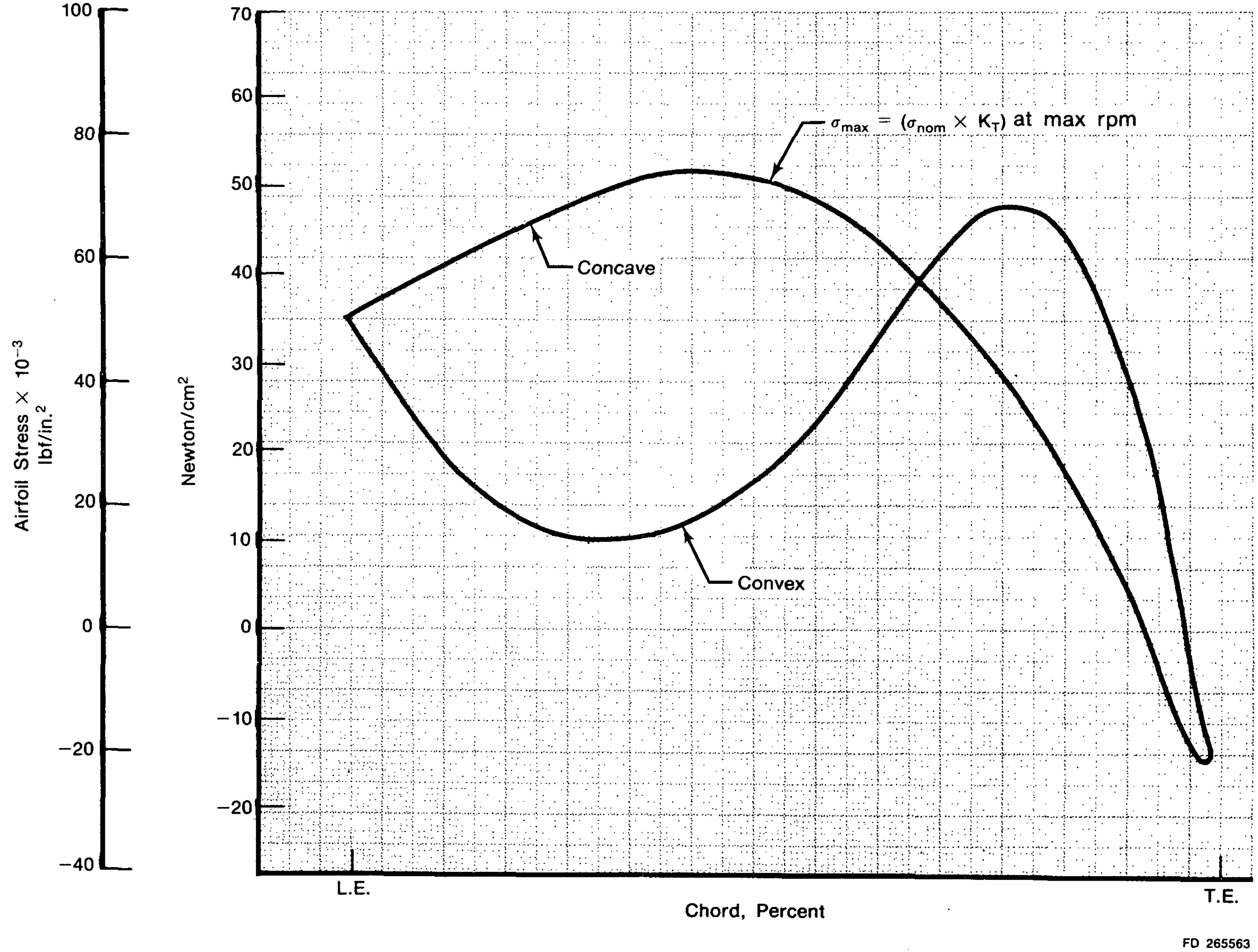

Figure 47. NASA V/STOL Fan Maximum Concentrated Stress at the Flowpath Splitter

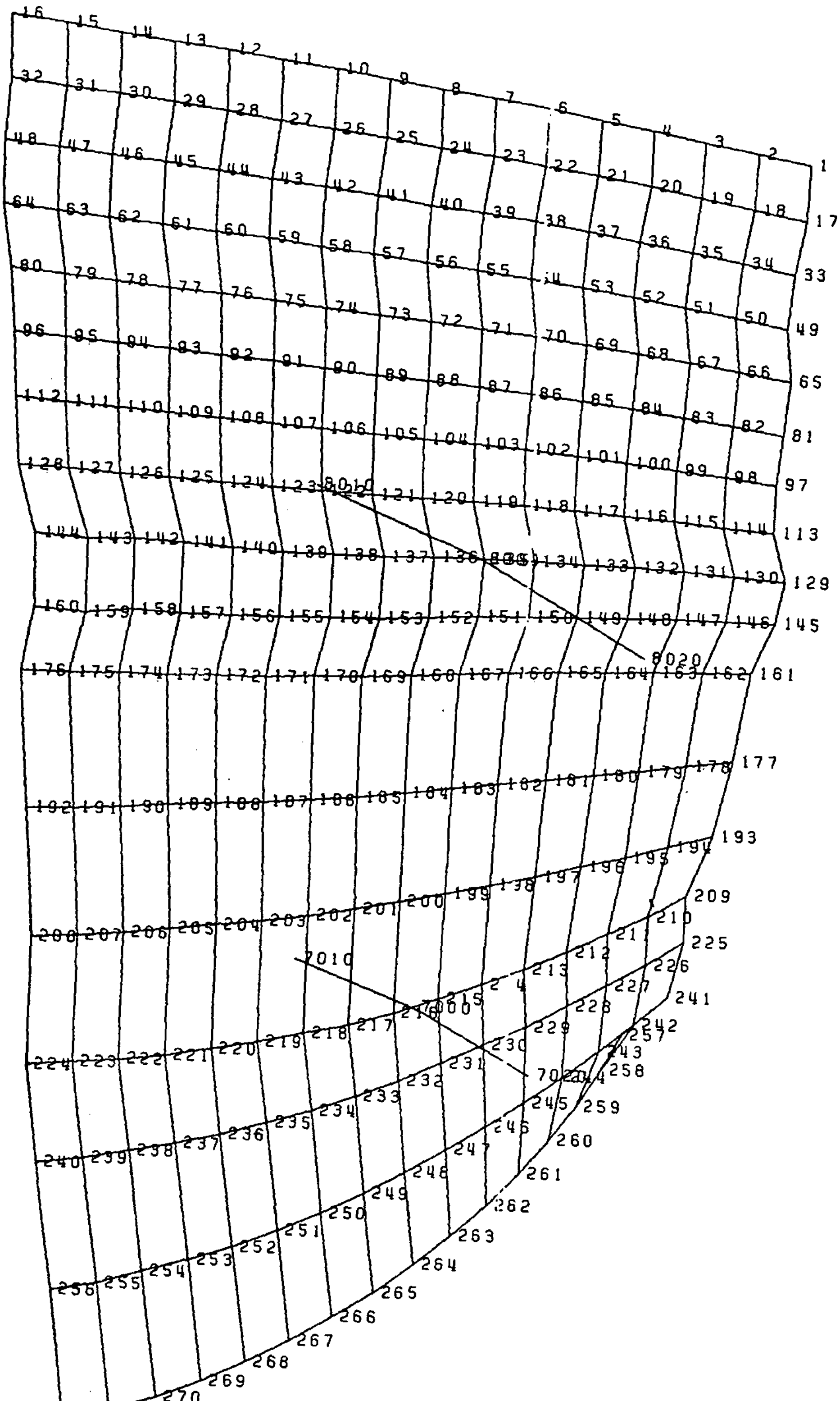

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Figure 48. Blade Free Vibration Finite Element Model

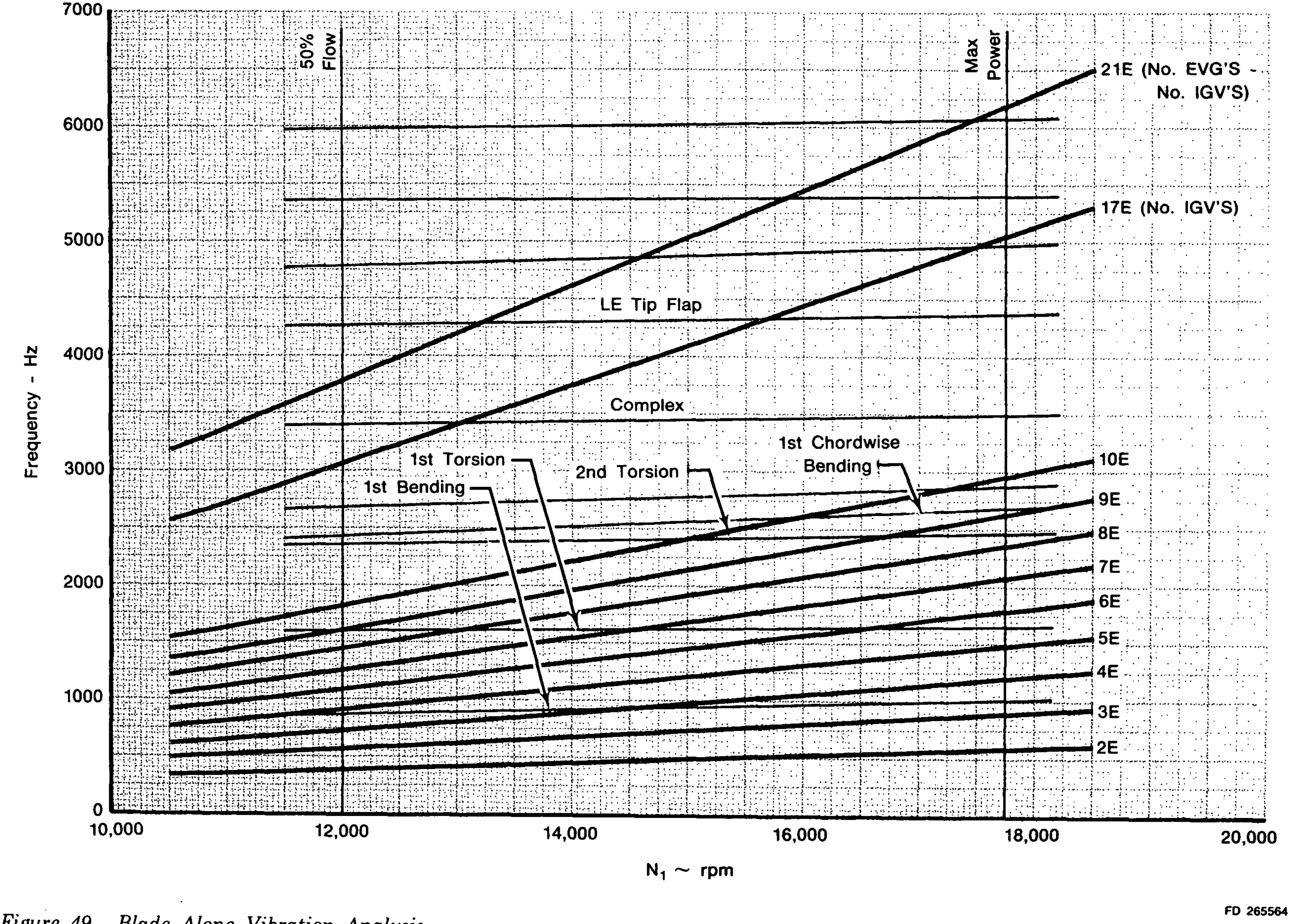

Figure 49. Blade Alone Vibration Analysis

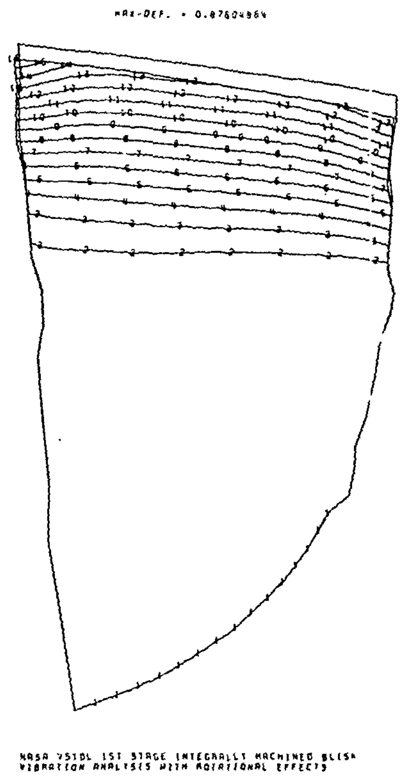

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Figure 50. Blade Modal Deformation at 17,750 rpm, Mode 1, 1010.988 Hz

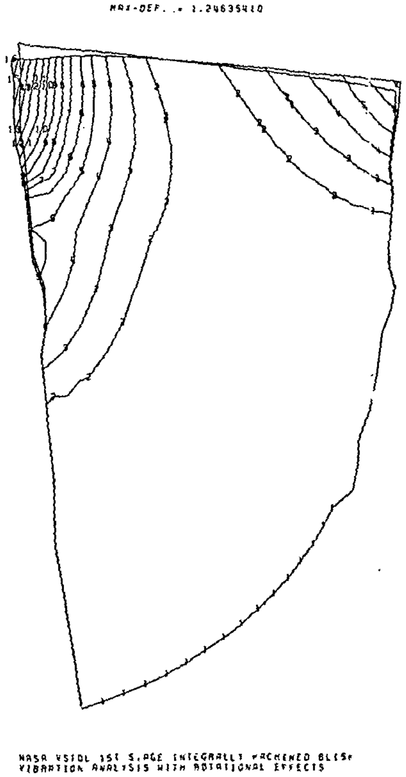

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Figure 51. Blade Modal Deformation at 17,750 rpm, Mode 2, 1637.072 Hz

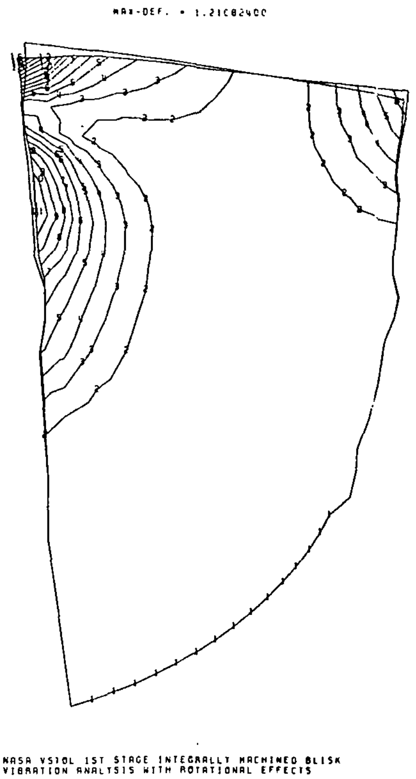

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Figure 52. Blade Modal Deformation at 17,750 rpm, Mode 3, 2472.997 Hz

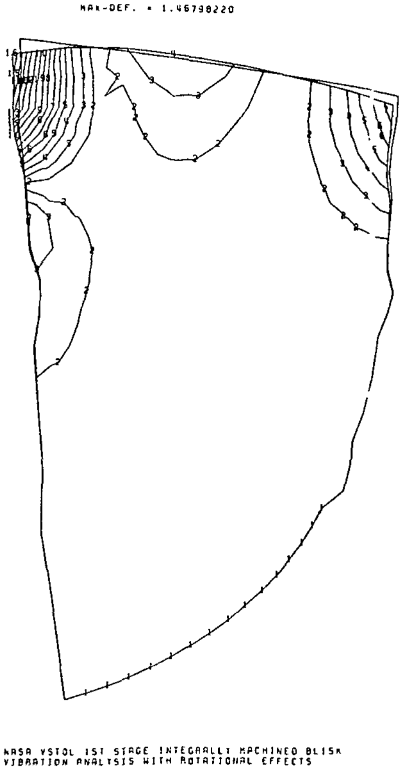

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Figure 53. Blade Modal Deformation at 17,750 rpm, Mode 4, 2690.768 Hz

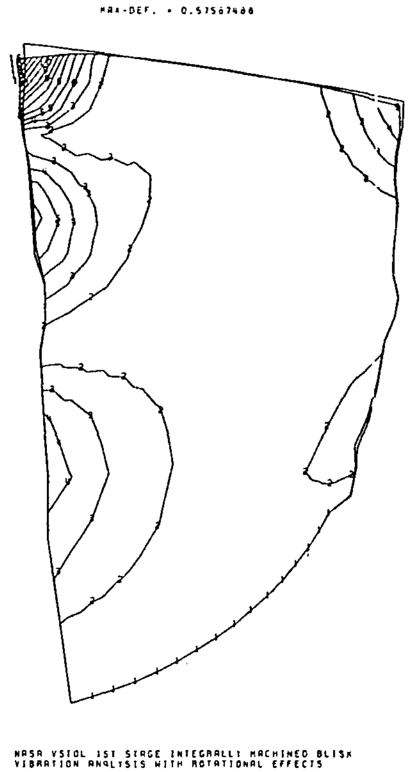

Figure 54. Blade Modal Deformation at 17,750 rpm, Mode 5, 2863.475 Hz

Tip mode analysis indicates there are 3 higher order complex modes which are within the 17E excitation in the 50% flow (12,000 rpm) to maximum power (17,800 rpm) running range. These consist primarily of a complex mode at 3497 Hz (Figure 55), a LE tip flap mode at 4360 Hz (Figure 56) and a LE bending mode at 4951 Hz (Figure 57). They occur well above the typical chordwise bending modes of concern in fan designs and, based on experience, are normally moderate to low risk. However, due to the wide incidence range within which the blades will be required to operate, it is recommended that extensive testing be done to position a tip strain gage and establish stress ratios that will permit accurate monitoring of tip modes as well as the fundamental vibratory modes during rig tests. Figures 58 and 59 are modal displacement plots for the blade at frequencies intersecting 17E and 21E (# EGV-# IGV) near max power, i.e. 5378 and 6053 Hz. Table 8 summarizes the rotor vibratory frequencies for 0 rpm, 12,000 rpm (50% flow) and 17762 rpm (maximum power).

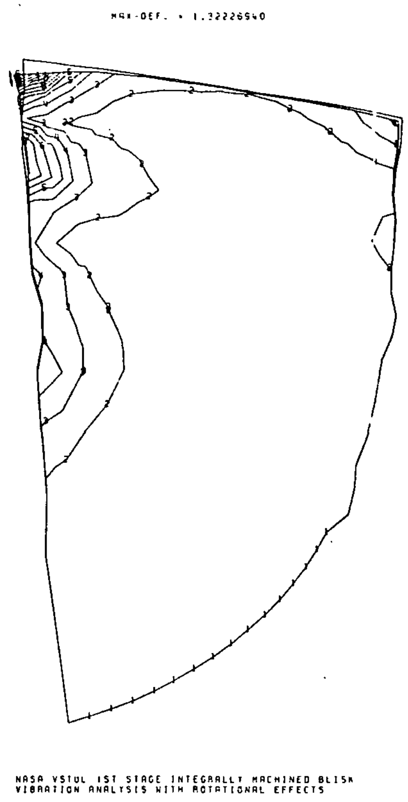

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Figure 55. Blade Modal Deformation at 17,750 rpm, Mode 6, 3497.499 Hz

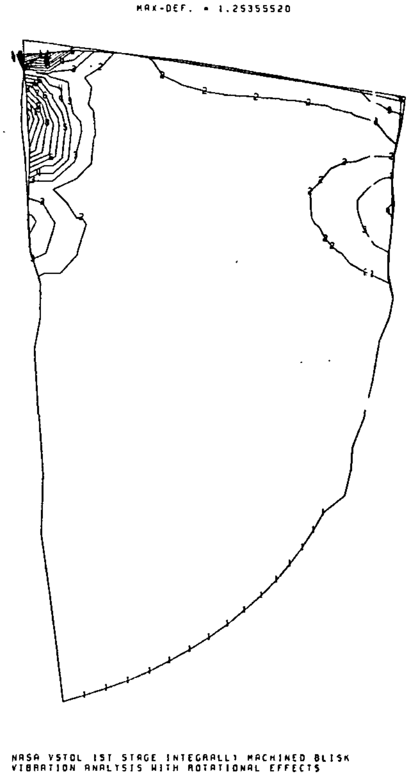

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Figure 56. Blade Modal Deformation at 17,750 rpm, Mode 7, 4360.125 Hz

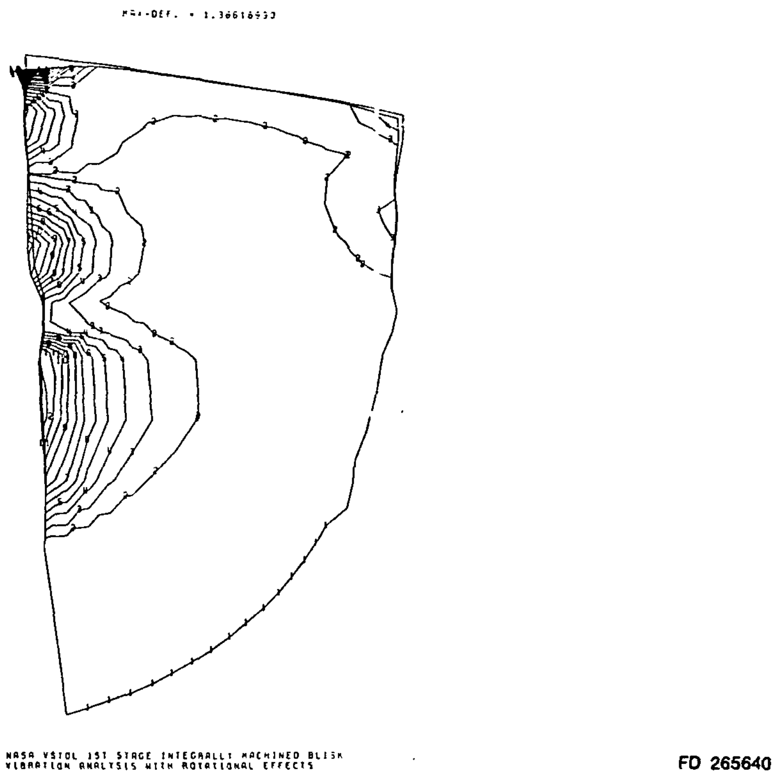

Figure 57. Blade Modal Deformation at 17,750 rpm, Mode 8, 4950.768 Hz

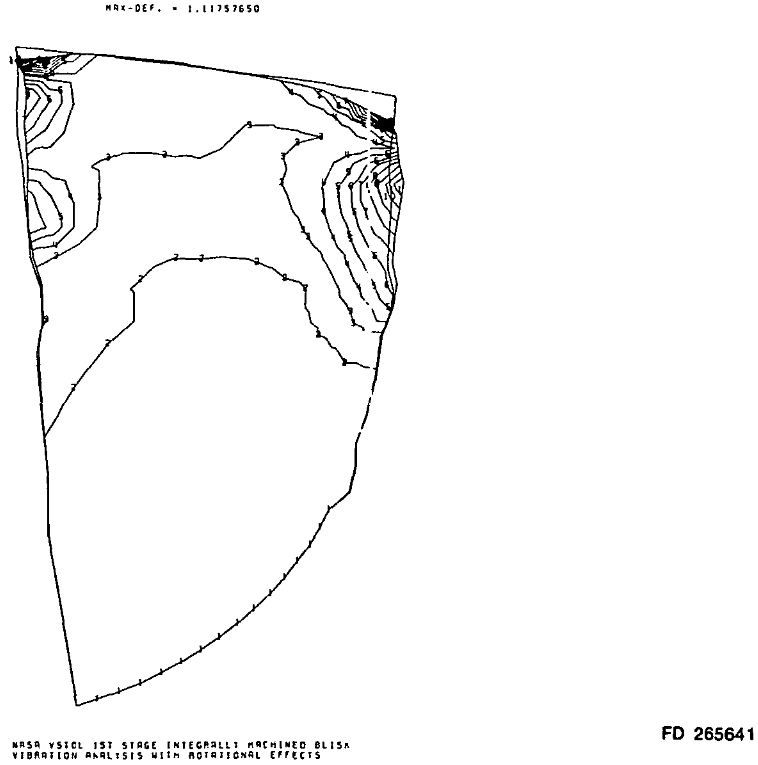

Figure 58. Blade Modal Deformation at 17,750 rpm, Mode 9, 5377.659 Hz

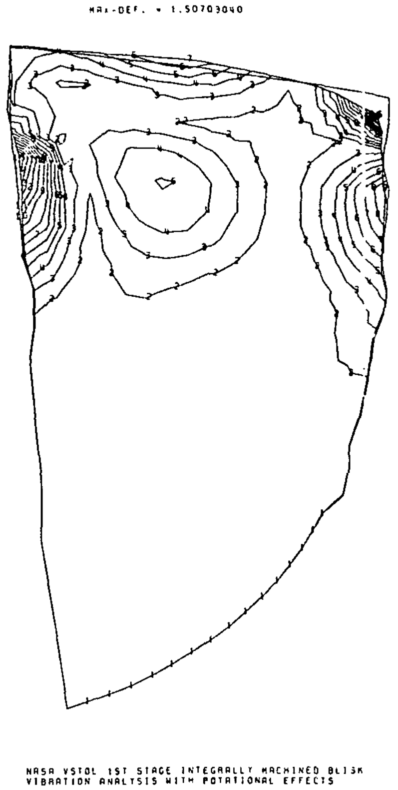

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Figure 59. Blade Modal Deformation 17,750 rpm, Mode 10, 6052.523 Hz

TABLE 8. — V/STOL BLADE FREQUENCY SUMMARY

Mode Shape	*0 rpm*	*12,000 rpm*	*17,776 rpm*
1st Bending	716	864	1011
1st Torsion	1554	1593	1637
2nd Torsion	1834	2357	2473
2 Nodal Tip	2358	2416	2691
1st Chordwise Bending	2674	2681	2863
Complex	3256	3371	3497
LE Tip Flap	4200	4275	4360
Complex	4650	4790	4951
Complex	5298	5335	5378
Complex	5916	5979	6053

3834C

Flutter

A supersonic unstalled flutter analysis was conducted for the fan blade at maximum flow conditions. The results of this analysis are shown in Figure 60. The blade exhibits positive aerodynamic damping for the first four modes of vibration, and no flutter/instability problems are predicted.

Durability

A Goodman diagram for the V/STOL fan blade is presented in Figure 61. Combined steady stress and vibratory stress levels were computed at several locations on the blade for 1st bending and 1st torsion modes. Vibratory stresses were normalized by assuming a maximum vibratory stress of 21K Newtons/cm^2(30K psi) peak to peak for each mode of vibration. The plot shows that the blade has in excess of twice the endurance limit capability of the material and will provide adequate HCF durability during test.

Vane Analysis Steady Stress

Steady stress levels for the inlet guide vane and the exit guide vane were computed using the airfoil stress deck. Very low stress levels ($<$ 10% Y.S.) were predicted for all points analyzed. Stress levels for the variable vane actuation rods were also predicted to be low even during surge (5 $\times$ airload) conditions.

Vibration

Natural frequencies and mode shapes for the inlet guide vane and exit guide vane were determined using VIBRA/NASTRAN and treating the fixed and variable segments of the vanes as independent systems. The analyses predict that all vane fundamental modes will be below the 24E excitation source of the rotor and no resonance problems are anticipated. Campbell plots summarizing these results are presented in Figures 62 through 66.

Flutter

Pressure ratio vs V parametric correlations were conducted in accordance with P&WA guidelines for both the inlet guide vane and the exit guide vane systems. These results are summarized in Figures 67 and 68 and indicate that the vanes meet the established flutter design experience curves. However, we have no practical experience or calibrated analytical technique for more accurately verifying the degree of stability of a LE flap configuration such as exists for the exit guide vane. Consequently, we recommend that the exit guide vane flap be instrumented to monitor vibratory stress levels for this airfoil.

RECOMMENDED STRAIN GAGE LOCATIONS

The airfoils of the proposed V/STOL rig satisfy the general P&WA fan design criteria but in light of the unique blade design and inherently low mechanical damping of the blisk, it is recommended that both steady and vibratory stress levels be monitored during testing as a rig health precaution and to verify the analytical predictions. The recommended location and orientation for four blade and one EGV strain gage are presented in Figure 69. Due to the limited capacity of the W-8 facility slip ring, and the recommended use of two steady stress gages (locations No. 1 and No. 3), only five gages can be monitored. These gages should be distributed on two blades 180 deg apart. No routing provisions for this installation have been provided by P&WA other than a 2.54 cm (1 in.) diameter hole through the blisk bore (L237441)

to permit rig testing in the 3.28m × 1.82m (9 ft × 5 ft) wind tunnel and the slip ring mounting scheme (L237442-sheet 4) for the W-8 test facility. A drawing (HKJ 3397) was provided detailing the EGV flap spindle hole required for strain gage routing to the suction surface of flaps 12 and 30.

CONCLUSIONS AND RECOMMENDATIONS

1. Airfoil steady stress levels are within the design allowable of 75% of 0.2% Y.S.

2. The airfoils are free of any expected integral order excitations for all fundamental vibration modes in the high power running range.

3. Blades and vanes satisfy the flutter design criteria.

4. Although the blade is predicted to have a 17E (17 IGV's) excitation crossing for 2 complex tip modes in the high speed running range, both modes are well above the typical chordwise bending tip modes normally of concern in fan designs.

5. The blades should be instrumented to monitor both steady state and vibratory stress levels during rig test.

6. The exit guide vane LE duct flap airfoil should also be instrumented to monitor vibratory stress levels for this unique airfoil configuration.

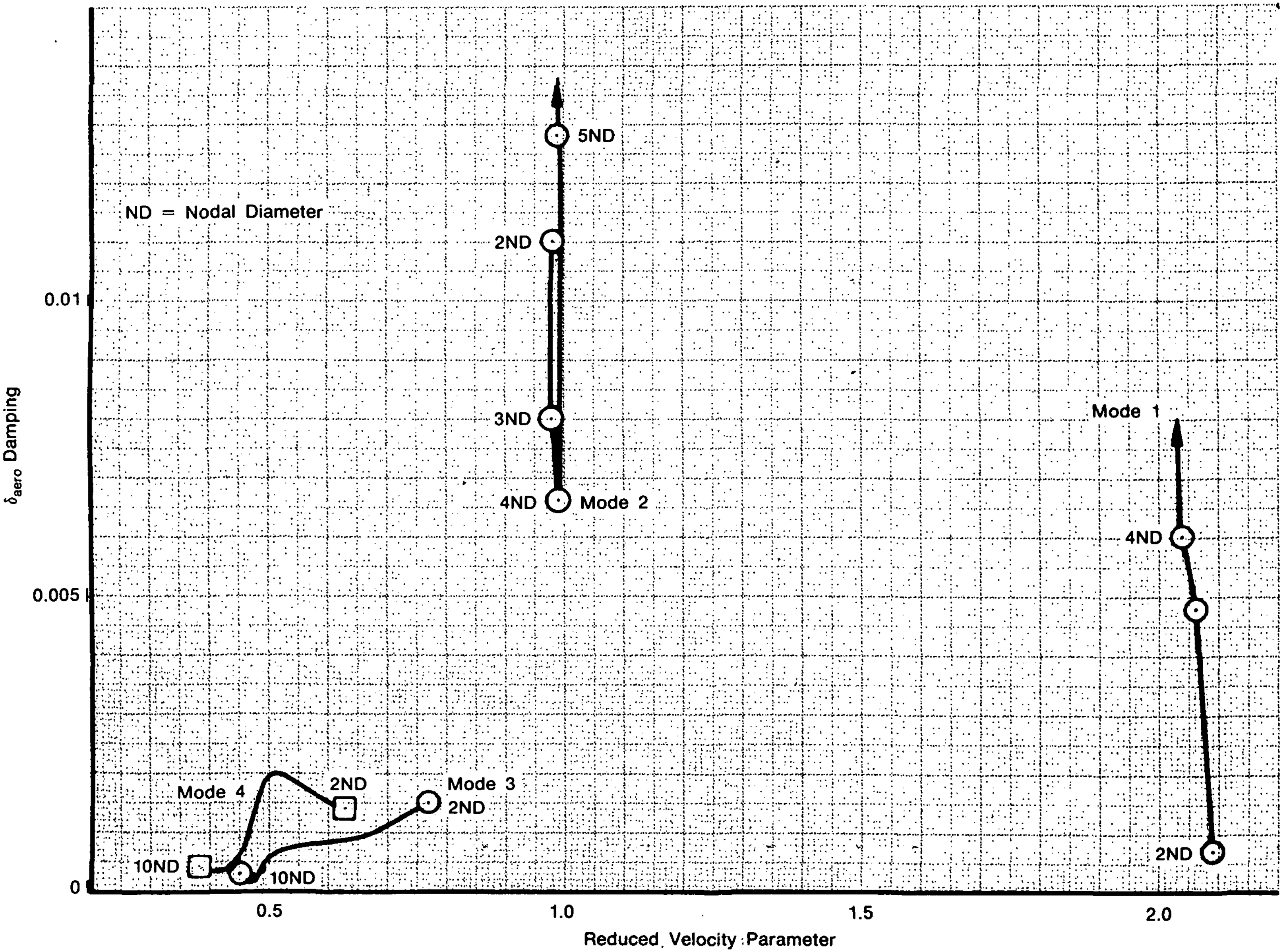

Figure 60. NASA V/STOL Fan Supersonic Flutter Analysis

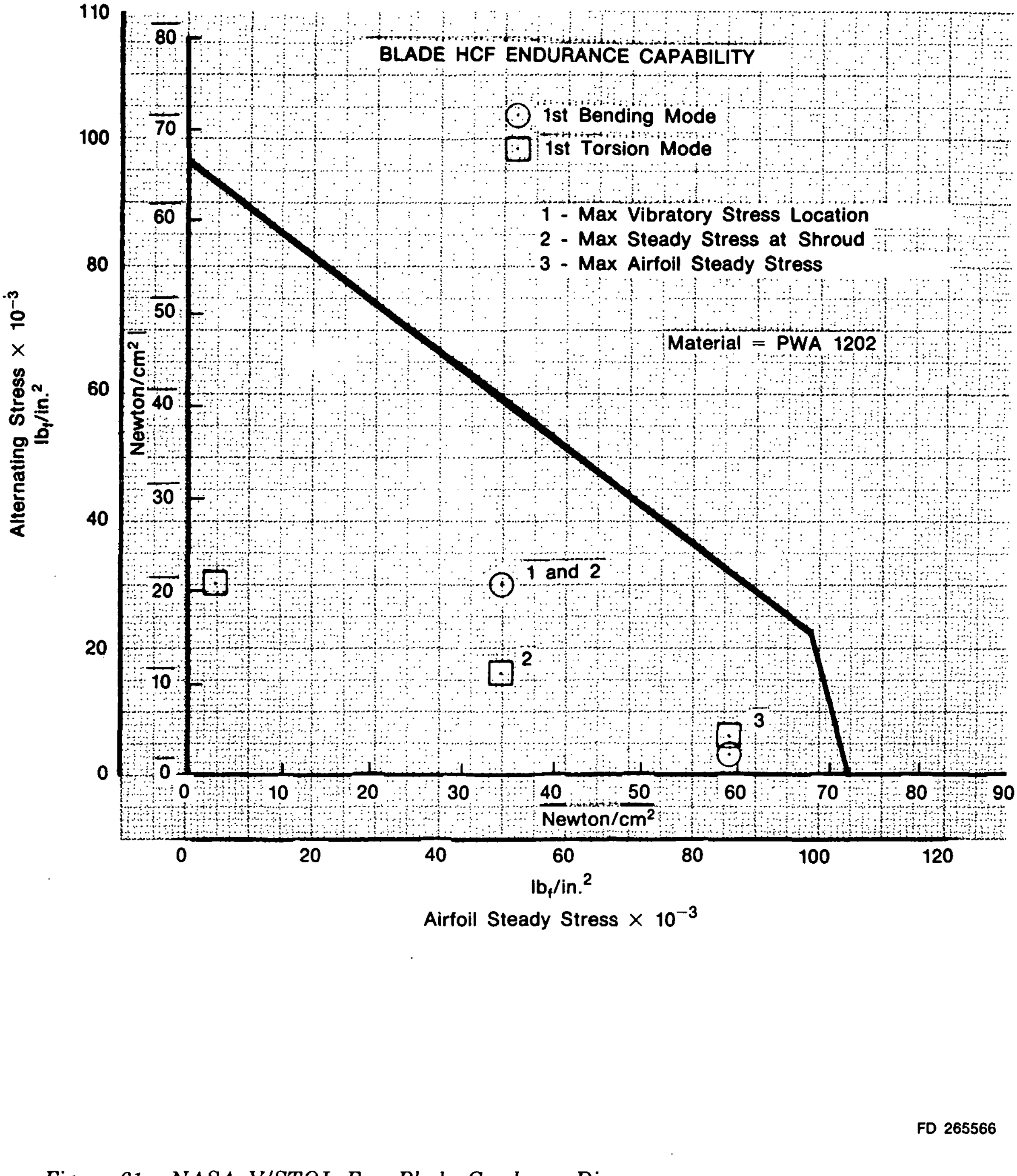

Figure 61. NASA V/STOL Fan Blade Goodman Diagram

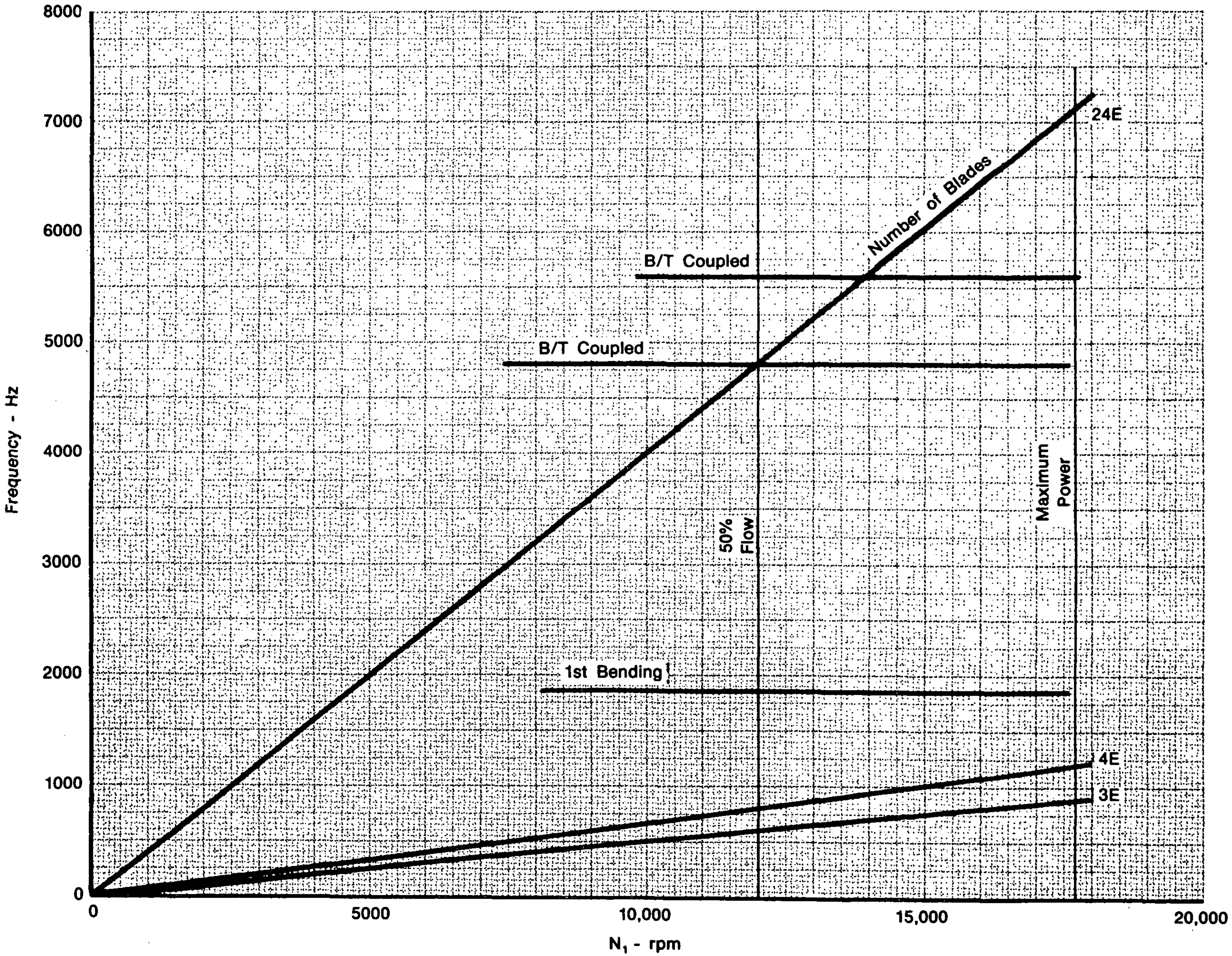

Figure 62. NASA V/STOL Fan Rig-IGV LE Strut Vibration Analysis

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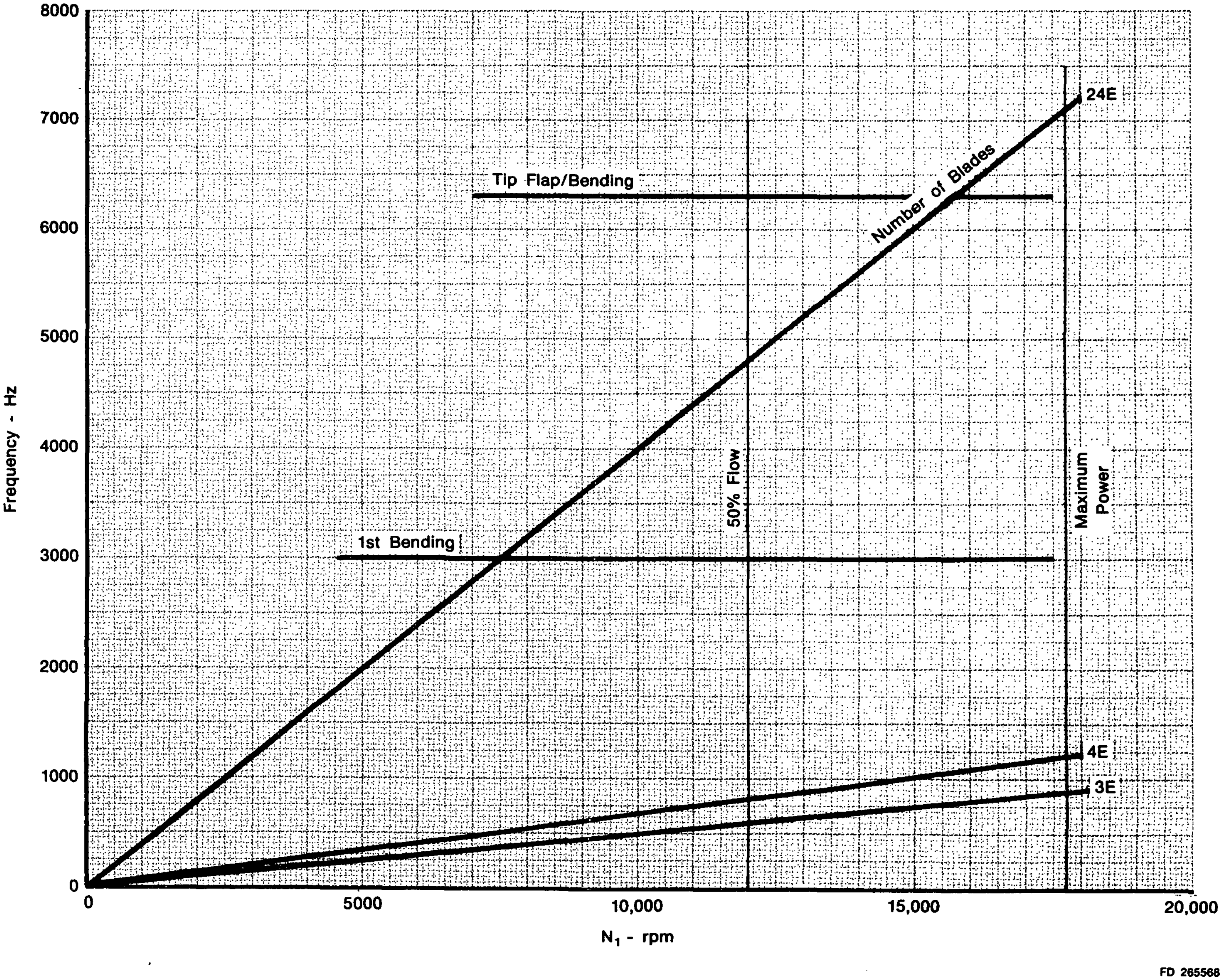

Figure 63. NASA V/STOL Fan Rig-IGV TE Core Flap Vibration Analysis

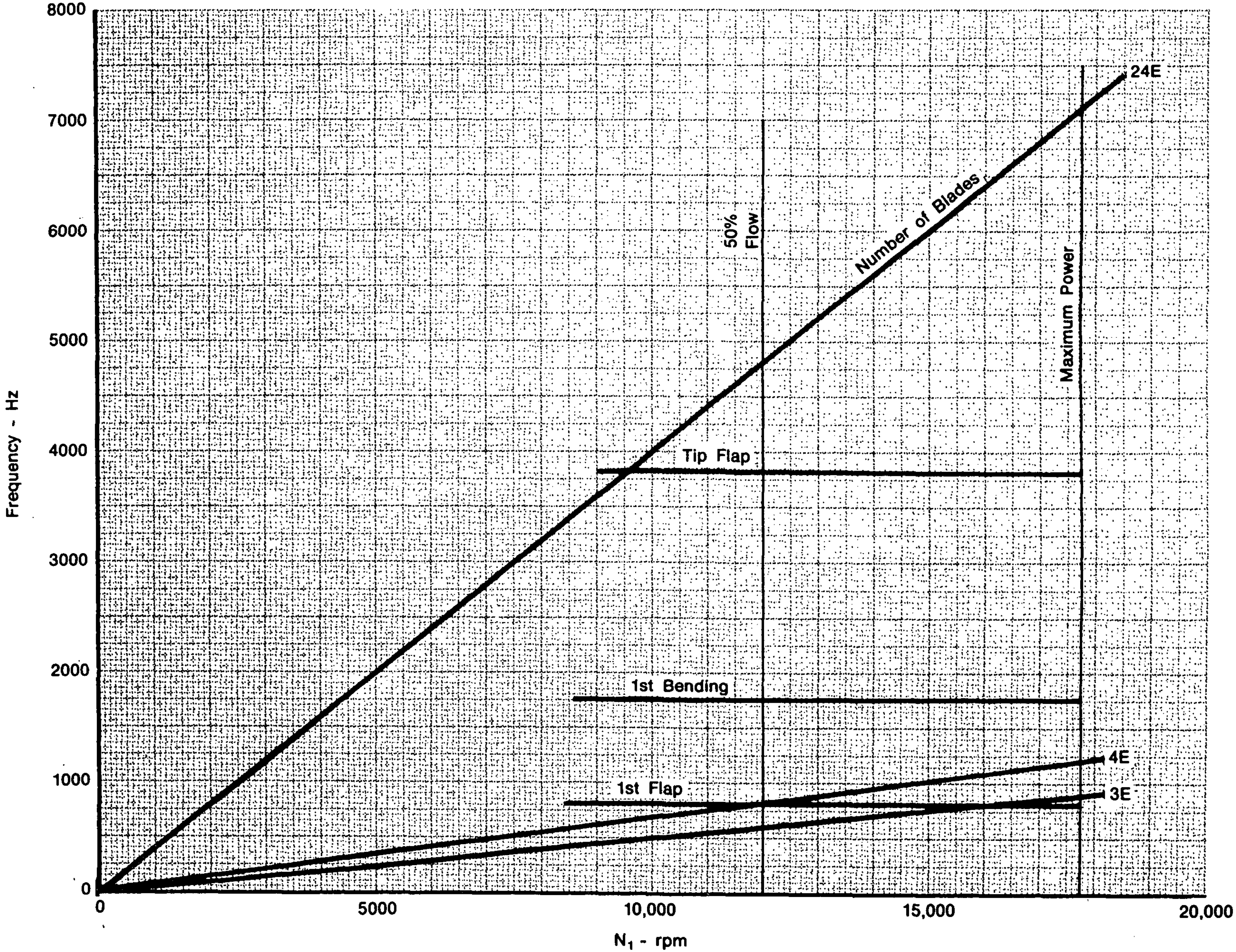

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Figure 64. NASA V/STOL Fan Rig-IGV TE Fan Flap Vibration Analysis

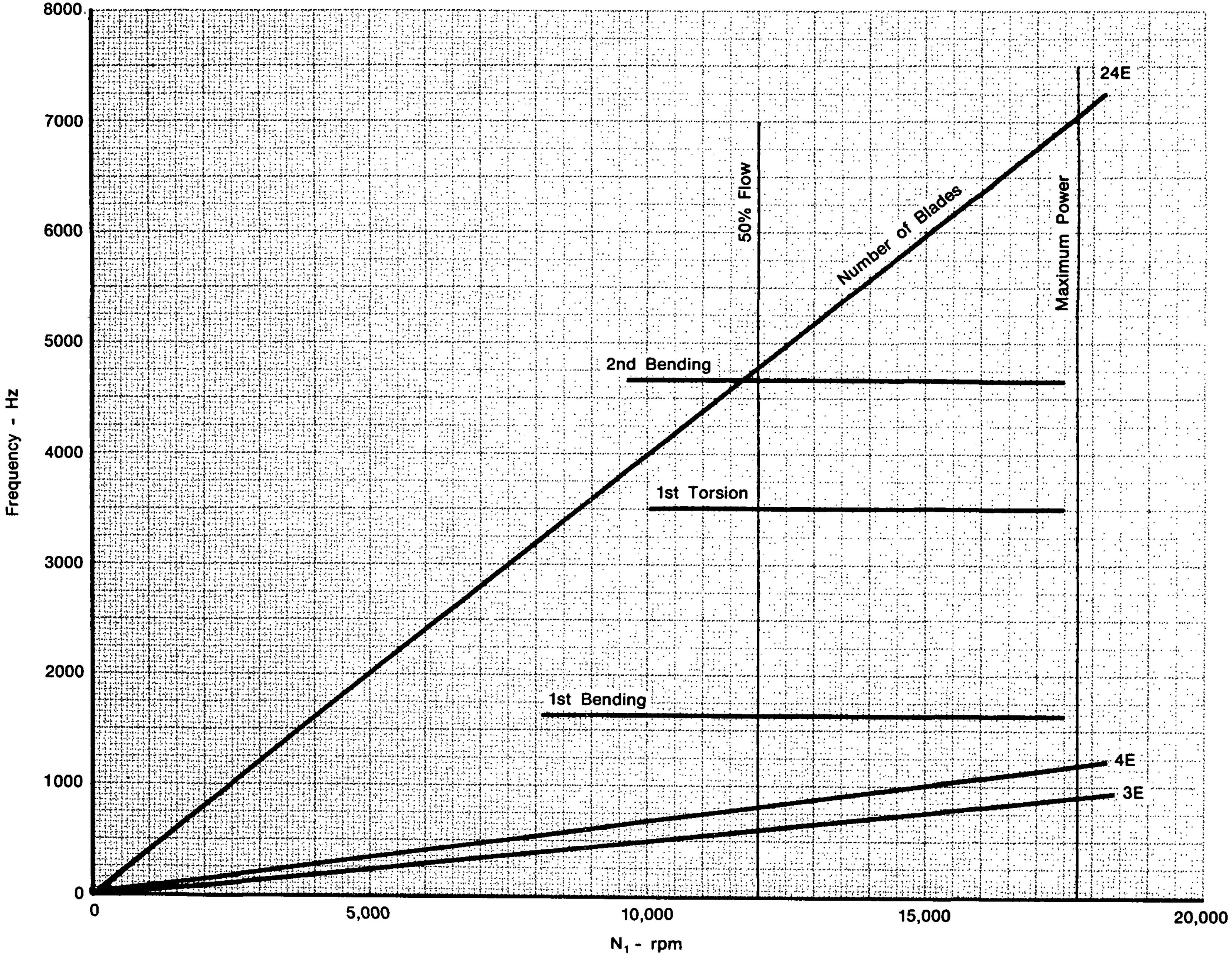

Figure 65. NASA V/STOL Fan Rig-EGV TE Strut Vibration Analysis

FD 265570

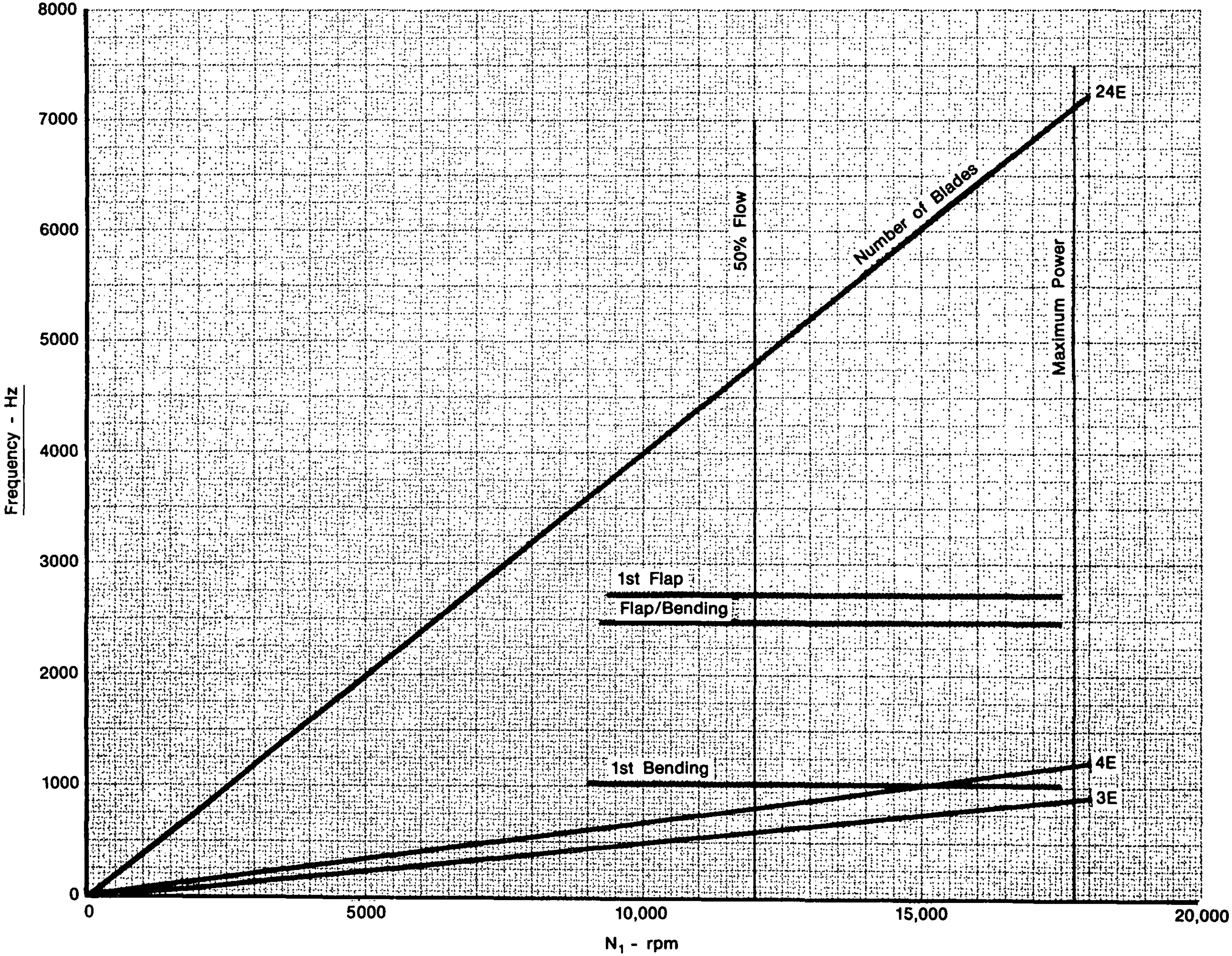

Figure 66. NASA V/STOL Fan Rig-EGV LE Duct Flap Vibration Analysis

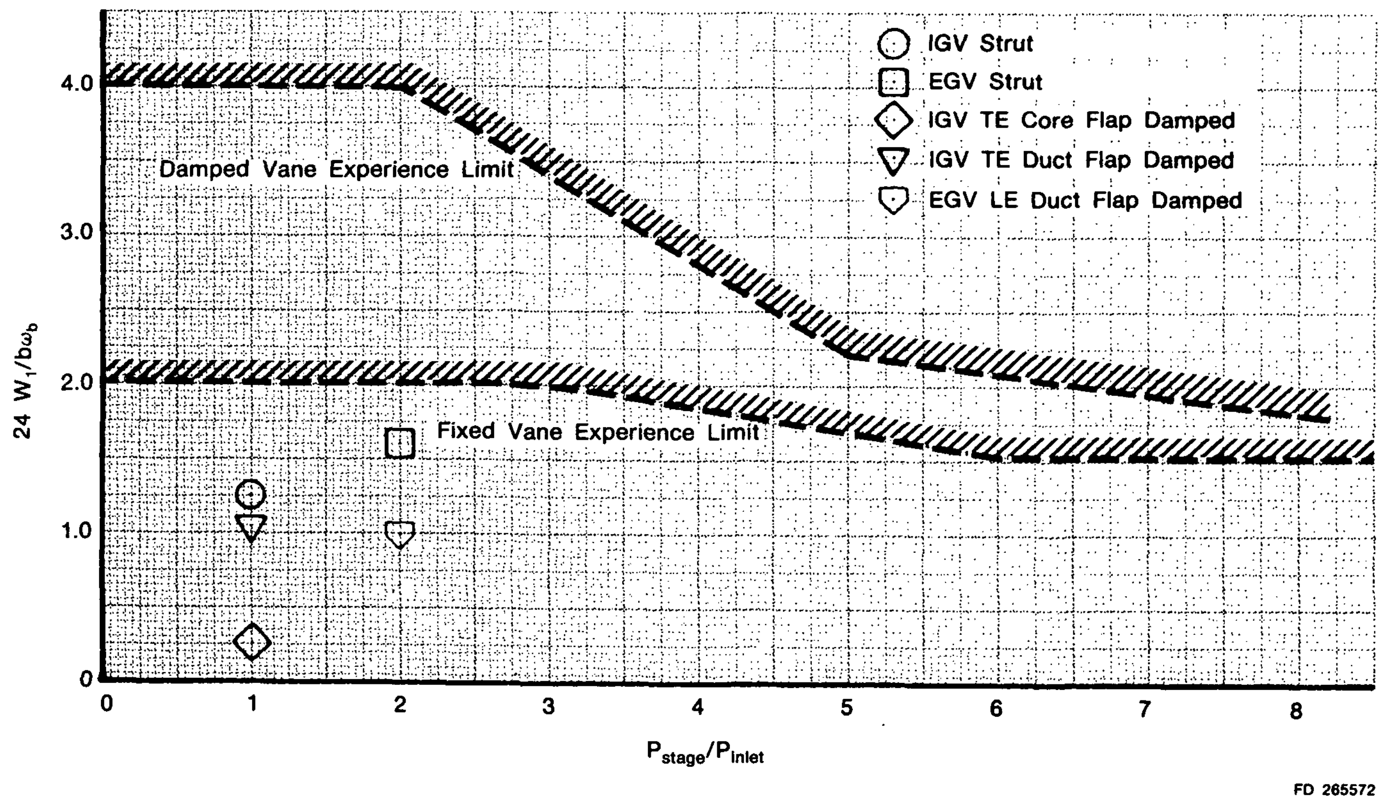

Figure 67. NASA V/STOL Fan Rig-Vane Bending Flutter Parameter

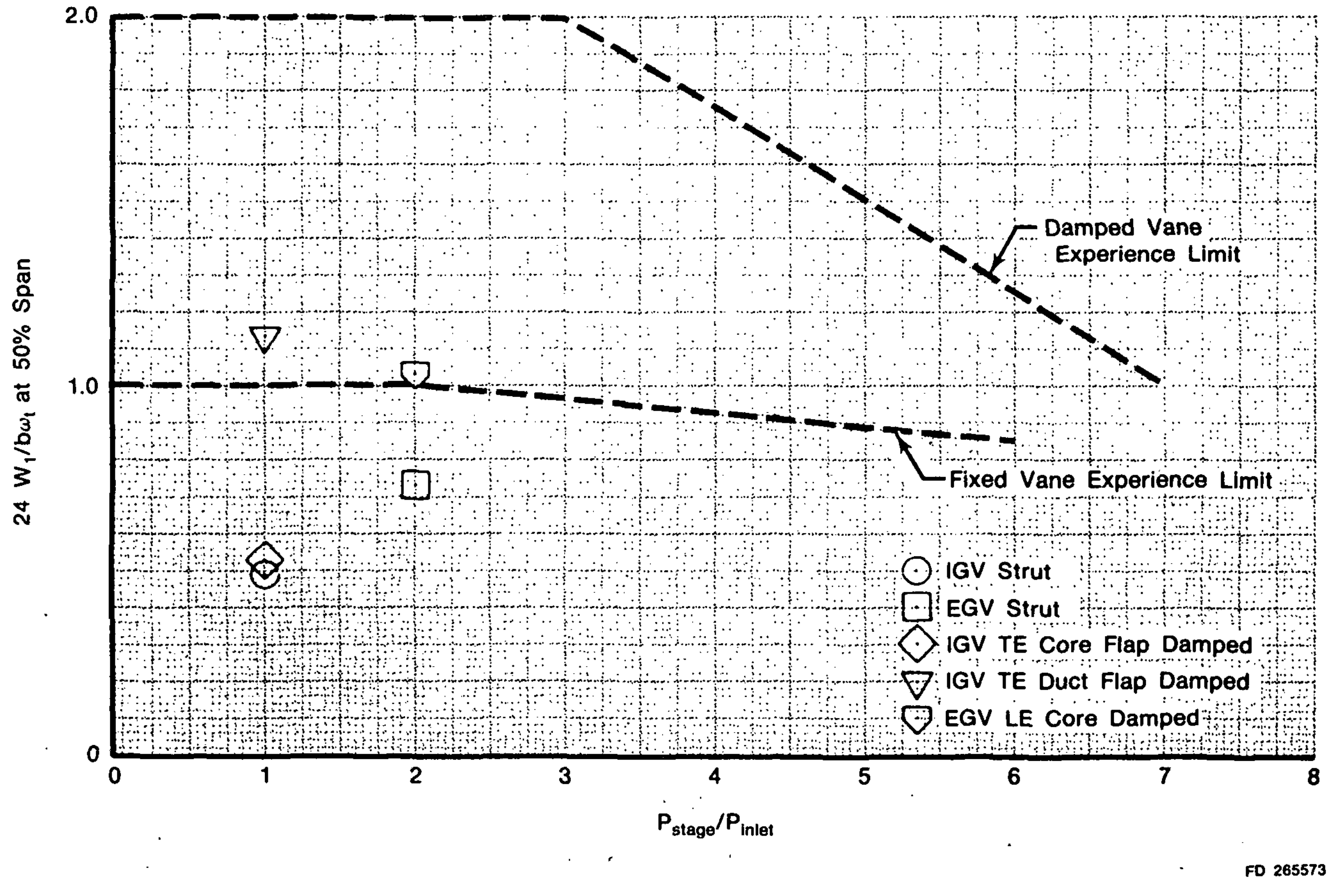

Figure 68. NASA V/STOL Fan Rig-Vane Torsional Flutter Parameter

Gage No.	Qty Req'd	Gage Type	Stress Ratio Data	Gage Orientation
1	1	Steady Stress Uniaxial	$\sigma_{gage} = 100\% \ \sigma_{ss}$	Convex Surface Just Above Fillet Radius Runout - Locate in Radial Direction
2	2	Vibratory Stress	$\sigma_{gage} = 100\% \ \sigma_{vib}$ 1B $\sigma_{gage} = 50\% \ \sigma_{vib}$ 1T	Convex Surface - Locate in Radial Direction
3	1	Steady Stress	$\sigma_{gage} = 100\% \ \sigma_{ss}$ on Shroud	Locate Midway Between Airfoils and Orient Tangentially to Measure Hoop and Bending Stress
4	1	Vibratory Stress	To Be Determined by Bench Testing	To Be Determined by Bench Testing
5	2	Vibratory Stress	$\sigma gage=100\% \ \sigma vib$	Locate Near Spindle in Axial Direction

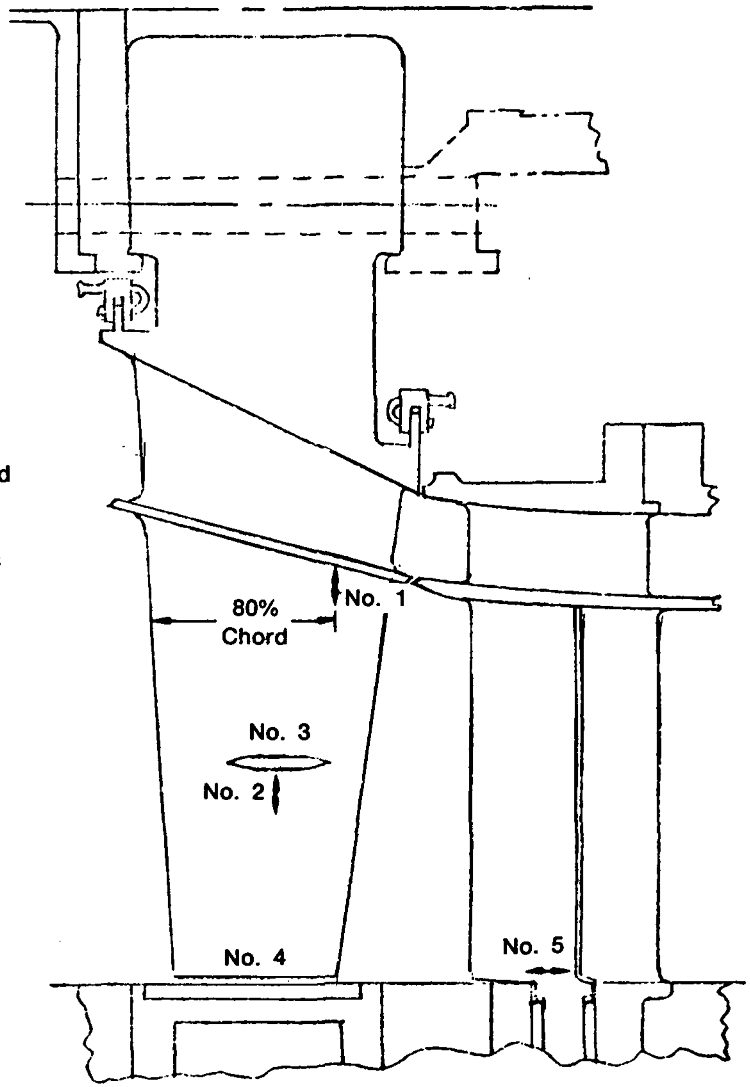

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Figure 69. Recommended Strain Gage Locations

SECTION VI
MECHANICAL DESIGN

The mechanical design of the dual flowpath V/STOL fan stage rig is presented in this section. The rig was designed to fit within the existing NASA LeRC W-8 facility, incorporate integrally machined rotor and stator cases to minimize cost and assembly time, and incorporate existing NASA actuation/position system components.The basic rig cross section is shown in Figure 70. The radial and axial flowpath rig station locations, dimensions, and actuation component placement are shown in Figure 71. Vane position read-out component design and placement are shown in Figure 72 and the slip ring support tube assembly is shown in Figure 73. The integrally bladed rotor is presented in Figure 74.

Material selection was consistent with reference parts (usually SAE 1010-1030 mild steel with an AMS 2485 black oxide finish) unless there were additional considerations. Inconel 718 (AMS 5665) material was used for the sync rings because of strength requirements. Greek ascoloy (AMS 5616) was used for the IGV and EGV strut cases, airfoil flaps and flowpath splitters because of raw material availability and instrumentation considerations. Aluminum was used for the slipring support tube and permitted as an optional material for the exhaust splitter because of weight. The rotor is to be machined from an 8.1.1 Titanium (AMS 4973) pancake forging.

Rig components other than airfoils were designed consistent with reference parts. Drawings of airfoils are done to engine specifications (PWA 360); all other components are of a format similar to reference drawings provided by NASA. An explanation of drawing symbols, material specification, and processes is provided in a separate volume (reference 5). The information available in this volume is further defined in Section VII. Airfoil coordinates are provided on tape in a 9 track, 1600 BPI, 80 block size format consistent with the requirements of numerically controlled milling machines and are tabulated in Appendix C in P&WA 390 format.

The design considerations and philosophy for the major rig subassemblies are presented from rig inlet to exit in the following paragraphs.

INLET CASES

The ID and OD inlet cases provide a transition between the existing W-8 plenum configuration as defined by NASA drawing No. CF 851937-B and the V/STOL fan stage rig IGV strut case. The cases are welded assemblies made of SAE 1010-1030 steel with a black oxide finish. The 2.032 cm (0.800 inch) thick OD case is designed to accept the required NASA station 0 and 1 instrumentation as described in Section VII. Similarly the ID case contains the station 0 instrumentation and is designed to support the slipring mount tube as shown in Figure 73. Both OD and ID cases have a 16 micro inch finish requirement for the flowpath surfaces and 6 jack screw holes at each flange end to facilitate disassembly. The ID case flanges each have four notches for routing the 56 scheduled static pressure lines into the plenum. NASA must grind 4 slots into the plenum strut assembly (NASA drawing No. CR 846186) matching those on the ID case and provide any umbilical system needed to route the instrumentation through the plenum wall.

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Figure 70. V/STOL Fan Rig-Vanes and Cases

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COLD

FLOW PATH DIMENSIONS*

1	2	3	RADIUS B	RADIUS C	RADIUS D
87.236	87.236	87.236	3.000	4.575	4.725
90.236	90.236	90.236	3.000	4.575	4.725
93.492	93.118	93.083	2.700	4.525	4.675
94.462	94.225	94.174	2.700	4.550	4.700
94.936	95.001	95.004	2.700	4.600	4.750
95.378	95.802	95.835	2.750	4.725	4.875
97.236	97.307	97.295	3.495	5.090	5.170
99.953	99.864	99.809	4.825	5.700	5.774
100.736	100.726	100.730	5.075	5.875	5.990
102.521	102.520	102.672	5.194	5.995	6.181
104.236	104.236	104.236	5.194	5.995	6.181
105.800	105.800	105.800	5.194	5.995	6.181
111.600	111.180	111.180	4.000	5.500	6.181
—	112.500	112.500	4.000	5.500	6.181
—	113.500	113.500	—	5.500	6.181
—	114.800	114.500	—	5.580	6.181
—	115.500	115.500	—	6.000	6.181
—	116.500	116.500	—	6.000	6.181
—	117.500	117.500	—	6.030	6.208
—	118.500	118.500	—	6.175	6.350
—	119.500	119.500	—	6.370	6.600
—	120.500	120.500	—	6.600	6.950
—	121.500	121.500	—	6.850	7.320
—	122.500	122.500	—	7.120	7.720
—	123.500	123.500	—	7.400	8.150
—	124.500	124.500	—	7.680	8.600
—	125.500	125.500	—	8.000	9.100
—	126.500	—	—	8.360	—
—	127.500	—	—	8.870	—
—	128.500	—	—	9.250	—
—	—	—	—	—	—
—	—	—	—	—	—

Figure 71. V/STOL Fan Rig-Vanes and Cases

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		UNITS PER ASSY 119	UNITS PER ASSY 109	UNITS PER ASSY	UNITS PER ASSY 104	UNITS PER ASSY 1	ITEM NO. ○	ITEM NO. △	UNITS PER ENGINE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL	REF PART NO.	SPECIFICATION OR REMARKS	~~G&D REQUIREMENTS~~
		/					124			HKJ 3374-5	PLUG	NOTE 13			
		/					123			HKJ 3374-4	BARREL	NOTE 13			
		/					122			HKJ 3374-3	PLUG	NOTE 13			
		/					121			HKJ 3374-2	BARREL	NOTE 13			
		/					120			HKJ 3374-1	PLUG	NOTE 13			
		X				4	119			HKJ 3374	X-RTNG INSTRU TUBE, ASSY OF	———		NOTES, 12, 14	
						4	118			HKJ 3377	PLUG	NOTE 13		NOTES, 12	
						4	117			HKJ 3376	PLUG	NOTE 13		NOTES, 12	
						4	116			HKJ 3375	PLUG	NOTE 13		NOTES, 12	
						1	115			HKJ 3381	SLIP RING SPACER	NOTE 13		NOTES, 12	
						1	114			HKJ 3380-2	TUBE SUPPORT LEFT HALF	NOTE 13		NOTES, 12 11(OPT)	
						1	113			HKJ 3380-1	TUBE SUPPORT RIGHT HALF	NOTE 13		NOTES, 12 11(OPT)	
			/				111			HKJ 3409-2	PLATE	NOTE 13		.188 THK	
			/				110			HKJ 3409-1	PLATE	NOTE 13		.188 THK	
			X			2	109			HKJ 3409	BRACKET-ASSY	———		NOTES 11, 12	
					/		106			HKJ 3405	COUPLER	AISI 410			
					/		105			HKJ 3404	COUPLER BRKT	AISI 410		.062 THK	
					X	2	104			HKJ 3403	COUPLER ASSY	———		NOTES 12, 22	
						4	102			HKJ 3411	MOUNT BRKT	NOTE 13		NOTES: 12 .188 THK	
						2	101			HKJ 3412	CONNECTOR	AISI 410		NOTES: 12, 22	
						2	100			HKJ 3410	CONNECTOR	AISI 410		NOTES 12, 22	

LAYOUT FOLLOW-UP LIST

(PARTS LIST CON'T FROM SH1)

CHANGES INCORPORATED 3-31-83 JGC

FOR EXPERIMENTAL ONLY
REASON: NONFLIGHT QUALITY HARDWARE

L-237442 SHEET 3 A

PRATT & WHITNEY AIRCRAFT GROUP

V/STOL FAN RIG VANES & CASES L-237442

Figure 72. V/STOL Fan Rig-Vanes and Cases

L-237442/3A

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Figure 73. V/STOL Fan Rig-Vanes and Cases

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Figure 74. NASA V/STOL Fan Blisk

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SLIP RING MOUNT TUBE

The slip ring mount tube is designed to permit installation and coupling of the NASA slip ring to the rotor while the plenum is in the forward position. (See Section VIII for assembly procedures). Once the slip ring/mount tube subassembly is coupled to the rotor, the plenum can be moved aft into position as the slip ring mount tube slides forward into the plenum on the ID flowpath forward and aft flanges. The split tube support (HKJ 3380) is then installed to rigidly position the mount tube during testing. A spacer, item 115 (HKJ 3381) of Figure 73, can be machined to properly locate the mount tube axially and prevent compression or extension of the fragile slip ring to rotor flex coupling. The mount tube is designed of 6061-T6 aluminum to minimize weight. The tube support is made of SAE 1010-1030 steel with a black anodize finish. No aerodynamic fairing or nose cone was designed to cover the split tube support; NASA must design this hardware after devising a routing scheme for the instrumentation through the plenum.

INLET GUIDE VANE (IGV)

The inlet guide vane assembly shown in Figure 70 includes an integrally machined LE case with 17 struts and a full ring splitter which extends from 6.6 cm (2.6 in.) upstream of the IGV LE aft to the rotor LE (separating the core flow from the fan duct flow), independently variable core and fan flaps, aft OD and ID cases and miscellaneous flap actuation components.

The IGV LE strut case was designed to be integrally machined as opposed to welded or bolted to save tooling, machining, and assembly costs and to improve concentricity, tolerances, and flowpath continuity. Greek ascoloy (AMS 5616) material was selected because raw material was available, it will not rust when highly polished, and is easy to machine and instrument.

The aft ID and OD cases bolt to the LE strut case along the plane of the IGV core and fan flap spindle centerlines. The 8 deg tilt of the spindle centerlines decreases the fan flap TE OD endwall clearance in the axial position by approximately 0.25 cm (0.100 in.) and permits installation of the core flap through the integral splitter. A computer graphics generated picture of the strut case with the aft ID and OD cases but without core and fan flaps or LE and TE splitters is shown in Figure 75.

The splitter LE and TE ring segments are located on snap diameters and riveted to the strut case during assembly. It is important to note that the IGV core flap cannot be removed from the IGV assembly without first removing the splitter TE segment. The LE splitter/strut case junction was located upstream of the instrumentation Station 2 to simplify installation. The TE splitter/strut case junction was located close to the core flap spindle to minimize the raw material envelope and to maximize machining access. Station 3 splitter instrumentation must cross this junction; making IGV core flap removal after this instrumentation has been installed, very costly.

The aft ID case traps the core flap ID platform against the strut case ID to position the core flap and limit its radial movement. The fan flap platform is positioned radially by a flanged steel bushing with inexpensive Teflon inserts at the ends to provide low friction thrust and bearing surfaces for the flap spindle. The bushing was required following the line boring operation for the fan flap spindle platform. The bushing flange bolts to the strut case OD permitting removal of the aft OD case without disassembling the fan flaps. The fan flap bushing and the sync arms for both the core and fan flap are serialized to permit component matching with strut location. Matching is necessary because the flaps are dimensioned to nominal and will require individual hand fitting of components to obtain design endwall gaps during initial

assembly (see Section VIII). This dimensioning approach was taken to minimize performance losses due to greater than nominal endwall gaps. Serialization ensures correct reassembly.

The sync arm to spindle interface design insures positive engagement and the axial orientation of the tapered flats eliminate assembly problems due to tolerance stack-up. This design provides accurate chord angle control and leaves the spindle end clear for routing instrumentation. The sync arms incorporate available monoball bearing assemblies to reduce cost and procurement time.

The IGV core flap (T4060682) spindle/sync arm locating flats were oriented so that the X-axis of the airfoil as defined by the Engineering Master Drawings (EMD's) is parallel to the sync arm centerline. The core flap actuation system and endwalls were designed to permit + 20 deg rotation from the SLTO nominal or 0 deg position. The ADP position is +18 deg.

To minimize the axial movement of the IGV fan flap sync ring and the length of the sync arms, the fan flap (T4060681) spindle/sync arm locating flats were oriented such that the X-axis of the airfoil as defined by the EMD's is 20 deg closed (−) when the sync arm is axial (parallel to the rig centerline). To rotate the airfoil X-axis from +20 deg to −60 deg, the vane sync arm must be moved from +40 deg to −40 deg. SLTO nominal or 0 deg orientation of the airfoil X-axis therefore requires a +20 deg sync arm position. The ADP or +18 deg airfoil X-axis orientation requires a +38 deg sync arm position.

Full 360 deg sync rings were incorporated to reduce machining costs and eliminate vane angle variations inherent in split ring designs due to ovalization. The fan and core flap sync rings are positioned by 8 equally spaced 1.27 cm (0.500 in.) diameter Teflon plugs that slide along the IGV OD case as shown in Figure 70. The sync rings are each actuated at 2 points approximately 180 deg apart by existing NASA actuation systems. This sync ring support and actuation approach minimizes the number of components and maximizes sync ring concentricity. No mechanical stops to prevent over rotation of these sync rings and the damage resulting from vane end contact with the flowpath walls have been provided. NASA is responsible for setting actuator travel limits to prevent rig damage.

All IGV ID and splitter components were designed to accept the required station 1 and 2 static pressure instrumentation described in Section VII. The fan OD static pressures at the IGV LE and TE were installed in the inlet and rotor cases, respectively. The core TE ID case static pressure taps were designed as intersecting holes in a special "flange" to eliminate the potential interference of routed hypo tubing and the installation of balance weights on the forward flange of the rotor. Provision was also made for the routing of hypo tubing from the inlet duct ID along the surface of the IGV core strut to the fan side of the splitter to instrumentation Stations 1 and 2. When possible, instrumentation channels were made similar to NASA design practice and large enough to accept 0.062 in. diameter hypo tubing.

A cursory vibratory analysis of the IGV strut case, core and fan flaps was performed. No integral order resonances, torsional flutter response or other flow induced instabilities in the rig running range were present. No strut case stress analysis was performed. The core flap 0.51 cm (0.20 in.) diameter, 20.32 cm (8 in.) long spindle was calculated to deflect 0.5 degrees when a conservative 5 x normal surge airload of 4 Newtons (18 lbf) was applied; spindle shear stress for this condition was 5.5K Newtons/cm^2(8K psi). The allowable shear stress for AMS 5616 at 149°C(300°F) is 57% of the 0.2% yield strength or 41K Newtons/cm^2 (60K psi). The fan flap, although much larger, has a 1.27 cm (0.500 in.) diameter, 7.62 cm (3.00 in.) long spindle and no spindle stress or deflection problems are anticipated. However, the surge loads transmitted to the sync ring actuator pin were adequate to require a larger diameter pin 0.48 cm (0.190 in.) to reduce the 22.5 Newtons (100 lbf) airfoil surge load bending stress within the pin to an

acceptable 48K Newtons/cm^2 (7OK psi). The allowable bending stress for AMS 5663 at 38°C (100°F) is 150% of the 0.2% yield strength or 152K Newtons/cm^2 (220K psi).

Rotor Case and Tip Shroud Inserts

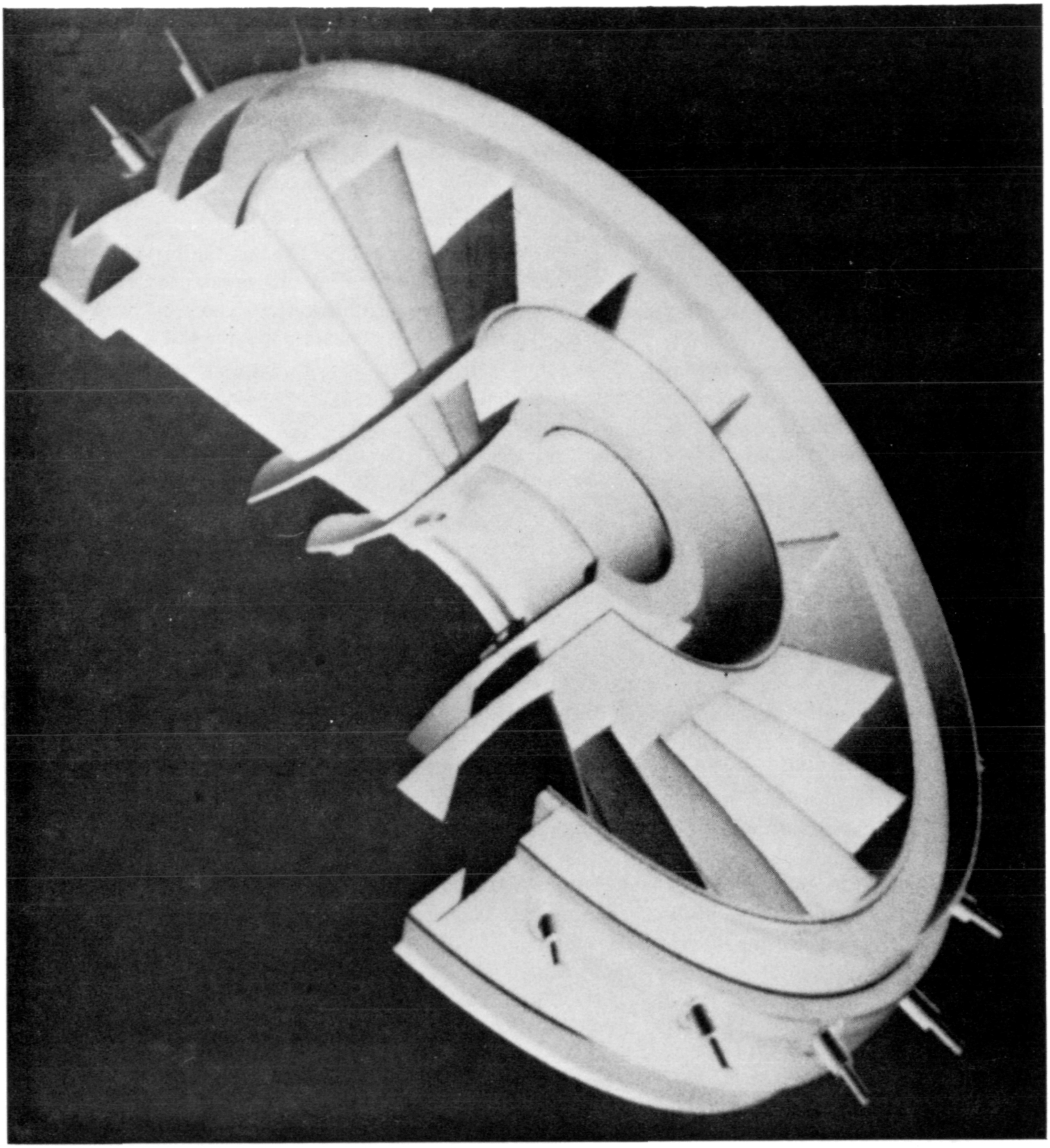
The rotor case (Figure 70) is designed to accept 2.54 cm (1.000 in.) deep tip shroud inserts and is split on the vertical plane per NASA request to permit on-stand tip shroud configuration changes. Alignment of the rotor case halves is maintained with 4 split line dowel pins; concentricity is insured with fore and aft snap diameters which also minimize split case ovalization. The IGV and EGV sync rings are located fore and aft of the rotor case flanges to permit case removal and ready access to rotor tip shroud instrumentation. The solid rotor tip shroud is coated with METCO 601 (a plasma sprayed mix of blended polyester and aluminum alloy powder) to permit shroud abrasion without blade tip damage. The shroud design provides 15 static pressure taps across the blade tip as defined in Section VII. NASA is to provide a scheme for routing this instrumentation to the rig exterior. Split line case bolt tensile stresses were calculated to be less than 2.1K Newton/cm^2(3K psi). No cold to hot rotor case flowpath dimensional correction was made for the predicted 0.019 cm (0.0075 in.) radial growth at the ADP thermal condition.

ROTOR

The rotor was designed as an integrally machined bladed disk (blisk) for cost savings, and incorporates a full ring splitter extending from LE to TE to separate core flow from fan duct flow and a full ring-part span shroud to eliminate low order fundamental mode resonances in the running range. Per NASA request, front and rear balance flanges were included for detail and assembly balancing as was a 1.27 cm (0.500 in.) dia hole through the disk bore for strain gage lead routing should the rig be tested in the NASA LeRC wind tunnel facility. These features are shown in Figures 76 and 77 which were generated with computer graphics using actual disk dimensions and airfoil coordinates, i.e., the "blisk" shown has yet to be fabricated.

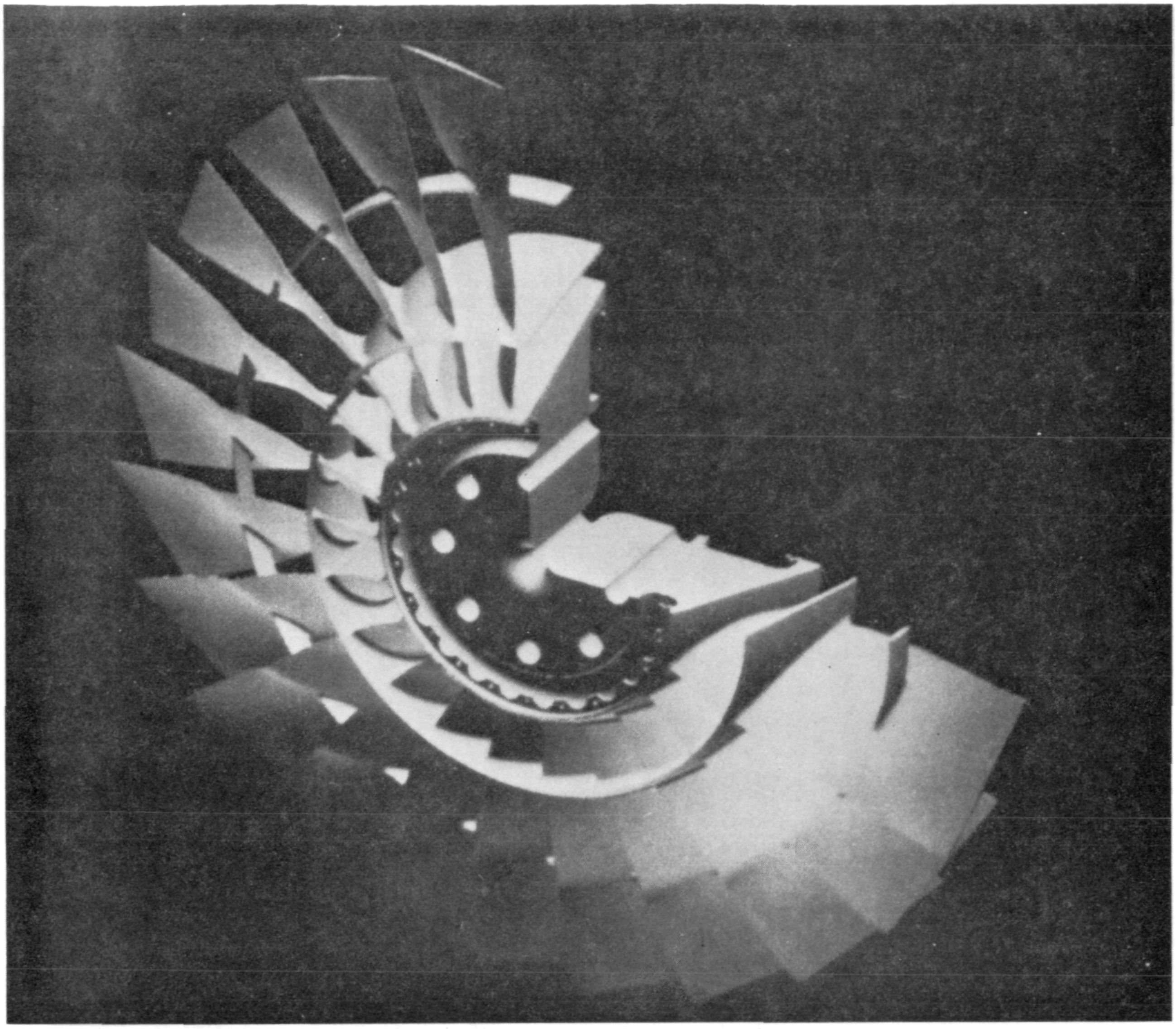
The disk configuration was copied from NASA designs to insure compatibility with the existing W-8 facility shaft and slip ring coupling. The blisk meets the general disk design criteria and has good LCF life as shown in Tables 9 and 10. Burst margin and yield margin are 2.362 and 2.213 respectively. All fillet radii were made as large as possible to avoid life problems (Figure 78) and still maintain functionality of the parts. The rear balance flange design was checked using a procedure based on P&WA experience which is conservative and calculates life using worst case tolerances with the largest balance weight permissible. The front balance flange was scalloped so that balance weights could be added to the rotor after assembly. The clearance holes for the bolts were based on what was used on reference NASA prints (CF 851447 and CC848383). The hole spacing as well as the single hole offset were selected to be compatible with NASA rig hardware. The radial dimensions of the blisk were converted from "hot ADP" to cold static conditions, i.e., the dimensions have thermal as well as dynamic growth factored into them to give the desired running clearances. The thermal conditions for which calculations were made are presented in Figure 79. The ADP running clearances are 0.051 cm (0.020 in.) for the blade tip and 0.0741/0.053 cm (0.029/0.021 in.) at the LE/TE of the flow splitter. The cold gaps at the flow splitter LE/TE are 0.056/0.910 cm (0.022/0.036 in.). Figure 80 presents a hot/cold running clearance summary.

3834C



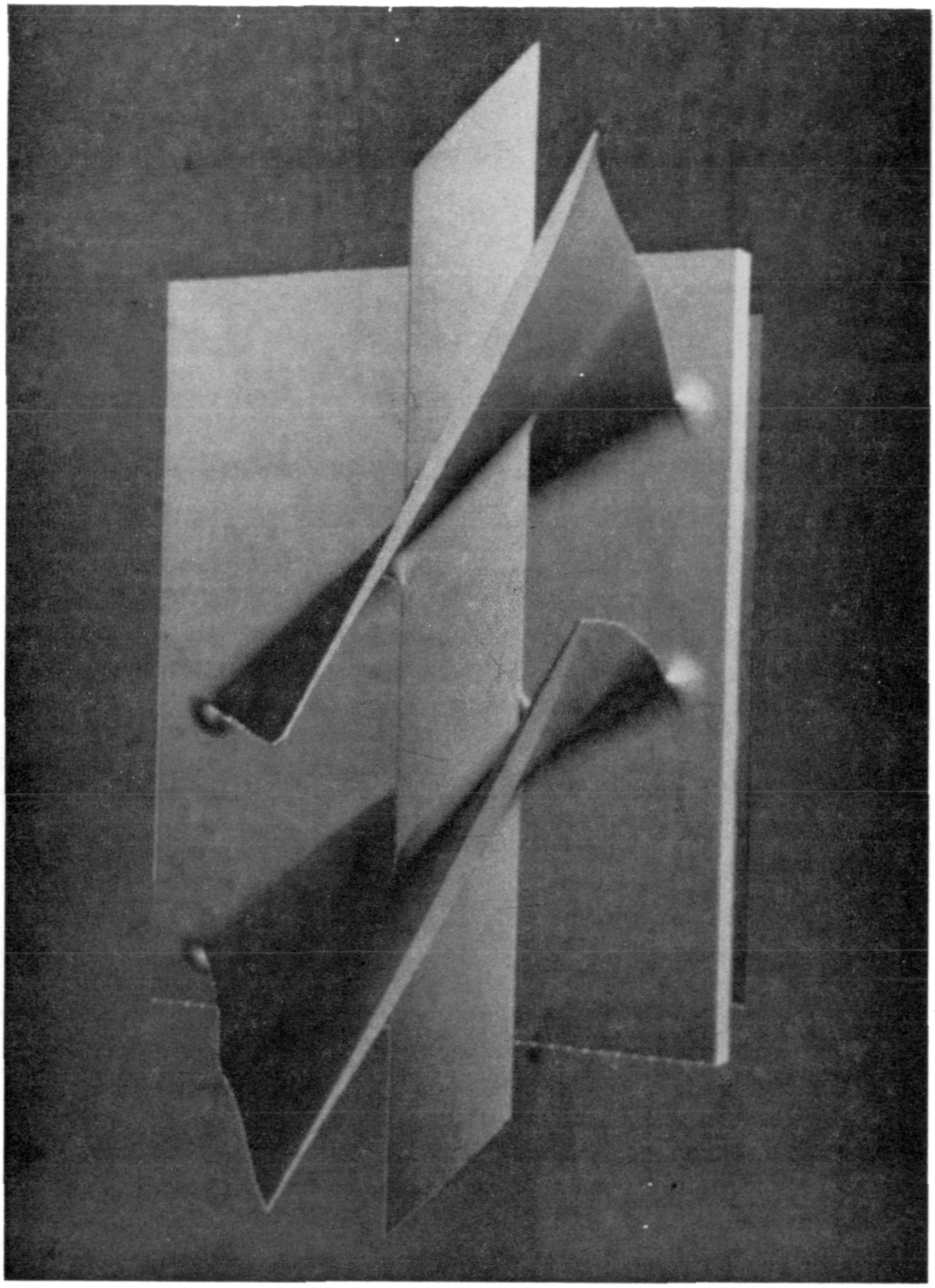
FC 83395-H

Figure 75. IGV Strut Case (Computer Graphics)



FC 83382

Figure 76. NASA V/STOL Fan Blisk (Computer Graphic)



FE 221508

Figure 77. NASA V/STOL Fan Blisk Airfoil/Section (Computer Graphics)

No tiebolt analysis was conducted since NASA is to provide the tiebolts.

A critical speed analysis is to be conducted by NASA because LeRC has all pertinent facility definition and an analytical model of the drive system. The rotor/blisk information necessary for performing a critical speed analysis is presented in Table 11.

TABLE 9. — V/STOL BLISK STRESS AND LCF SUMMARY

Stress Values are Newtons/cm² (lbf/in.²)

Flight Condition	No. of Blades	Speed rpm	Ave. Temp °F	Ave. Tan. Stress	Burst Margin (Note 1)	Yield Margin (Note 2)	Bore Temp	Dynamic Stress	Load Stress	Live Rim Load (Note 3)	$\rho\omega^2$ kg/cm³ sec² (lbm/in³ sec²) $\rho\omega^2$	Bore Tan Stress
ADP	24	17,762	68°C	14,031	2.362	2.213	68°C	5,954	8,077	249,331 kg	39.280	28,324
ADP	24	17,762	155°F	(20,350)	2.362	2.213	155°F	(8,635)	(11,715)	(549,680 lb)	(1,416.2)	(41,080)

Note 1 — Required burst margin is 1.15
Note 2 — Required yield margin is 1.00
Note 3 — Integral shroud and flow splitter were modeled as dead load and included in this figure
Note 4 — Blisk temperature is below creep range, i.e., not applicable

Flight Condition	Disk Radius	Ave Temp	Thickness	Radial Direct Stress	Allow	Stress	Effective Creep Allow	Yield Allow	Stress	Eff Combined Creep Allow	Yield Allow	Material (PWA 1202)
ADP	5.080 cm	68°C	7.137 cm	16,300	59,204	16,300	(Note 4)	73,883	16,300	(Note 4)	64,585	AMS 4973
ADP	2.000 in.	155°F	2.810 in.	(23,640)	(85,865)	(23,640)	NA	(107,155)	(23,640)	NA	(93,670)	AMS 4973

Bore LCF Life: Actual 50,000
BC LCF Life: Actual 50,000
Rim LCF Life: Actual 50,000

Snap Growth: Actual 0.000
Snap Growth: Allowable 0.010 cm (0.004 in.)

Disk Primary Stress Limiting Location: Rear Balance Flange Fillet Radius
Disk Secondary Limit: Bore LCF

TABLE 10. — V/STOL BLISK INTEGRAL ARM/BALANCE FLANGE STRESS SUMMARY

Stress Values are Newtons/cm² (lbf/in.²)

Flight Condition	rpm	Temp	Tang Stress Actual	Tang Stress Allow	Eff Stress Actual	Eff Stress Allow	Long Bend Stress	Radius	Defl	Slope
Location 1										
ADP	17,762	42°C	7,150	88,256	37,947	114,730	−4,737	10.973 cm	0.012 cm	0.014 cm
ADP	17,762	108°F	(10,370)	(128,000)	(55,035)	(166,400)	(−6,870)	4.320 in.	0.0046 in.	0.0055 in.
Location 2										
ADP	17,762	42°C	6,481	88,256	35,580	114,730	5,095	11.379 cm	0.011 cm	0.0 cm
ADP	17,762	108°F	(9,400)	(128,000)	(51,600)	(166,400)	(−7,390)	4.480 in.	0.0045 in.	0.0 in.

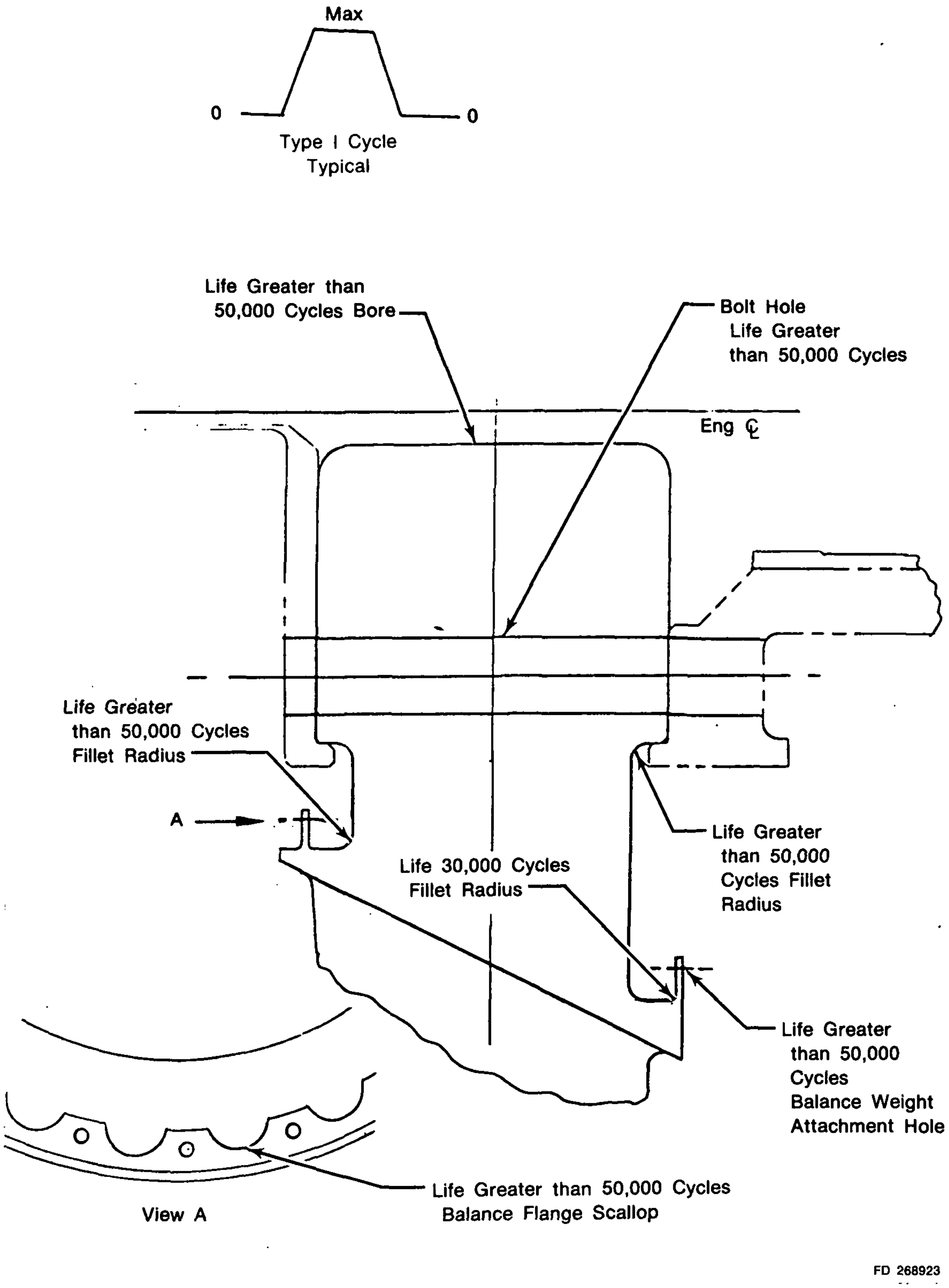


Figure 78. LCF Type I Life Cycle Summary

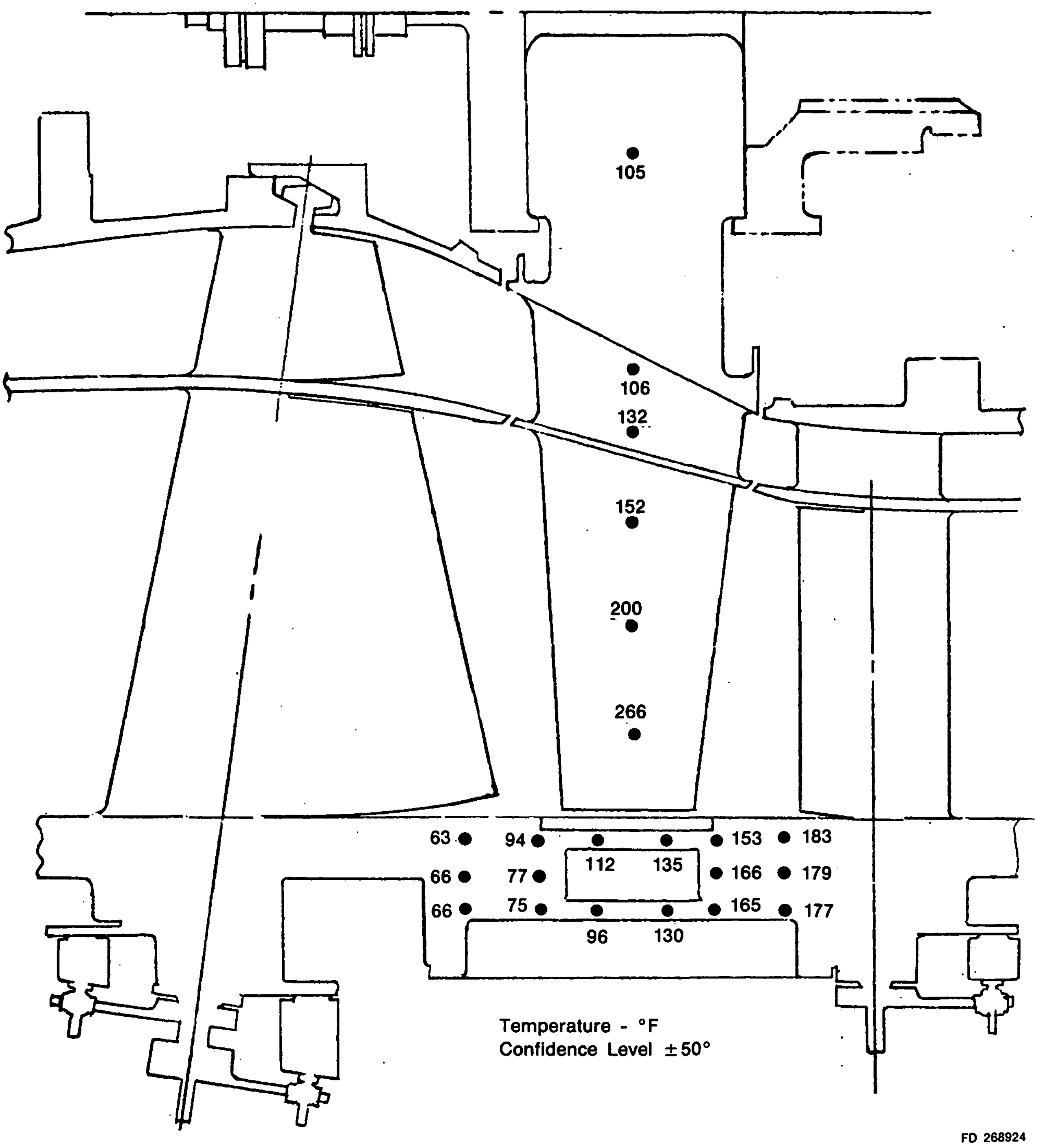


Figure 79. V/STOL Fan Rig Rotor/Case Thermal Map

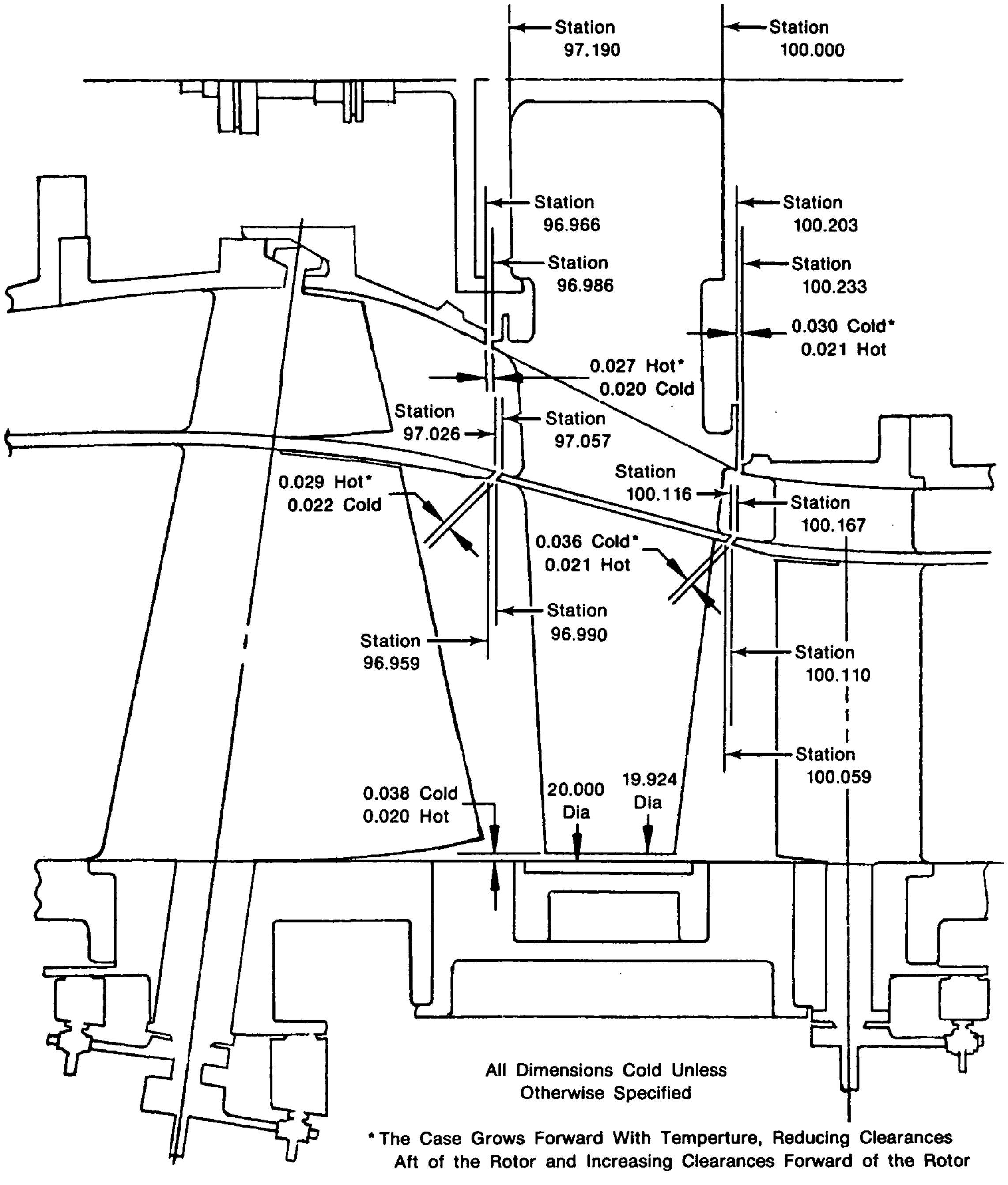


Figure 80. Critical Rotor Assembly Clearances (Minimum)

TABLE 11. — CRITICAL SPEED INFORMATION

Configuration	*Weight*	*Radius*	*Remarks*
Disk	9.750 kg (21.5 lbm)	6.736 cm (2.652 in.)	Centerline to ID flowpath
Blades	3.439 kg (7.584 lbm)	17.333 cm (6.824 in.)	ID flowpath to OD flowpath minus splitter ring intersection with blade. No fillet radii included.
Splitter	0.630 kg (1.39 lbm)	13.818 cm (5.44 in.)	Assumed full ring. No fillet radii were included.
Shroud	0.220 kg (.485 lbm)	19.304 cm (7.60 in.)	Assumed full ring (the shroud/airfoil volume is therefore duplicated). No fillet radii were included.
	Polar Moment of Inertia		0.5196 kg-cm-sec^2 0.451 lb-in.-sec^2

No provisions for routing SG leads were made for the V/STOL blisk.

In conclusion, the V/STOL blisk design satisfies accepted criteria and there are no areas of concern. The stress levels are in general low.

Exit Guide Vane (EGV)

The exit guide vane assembly shown in Figure 70 includes an integrally machined case with 38 vanes and a full ring splitter which extends from the rotor TE aft through the diffuser, an OD forward case, a variable LE fan flap and miscellaneous flap actuation components.

The EGV vane case was, like the IGV, designed to be integrally machined for cost savings and made of AMS 5616. The splitter extends aft of the EGV TE through the diffuser and is located on a snap diameter and riveted into place. The vane case/splitter junction was located close to the TE to minimize the EGV raw material envelope and to maximize machining access when fabricating the airfoils and installing instrumentation.

The forward OD case bolts to the vane case along the plane of the flap spindle centerlines. Flanged steel bushings with Teflon bearing inserts are used to locate the EGV LE fan flaps. The bushing flange bolts to the strut case OD permitting removal of the forward OD case. The bushing and the flap sync arm are serialized for component matching, and like the IGV flaps, require individual hand fitting of components during initial assembly to obtain the design endwall gaps. The sync arm to flap spindle interface design is the same as the IGV and available mono-ball bearing assemblies were again used to reduce cost and procurement time.

The EGV fan flap spindle/sync arm locating flats were oriented so that the X-axis of the airfoil as defined by the EMD is parallel to the sync arm centerline. The flap actuation system and endwalls were designed to permit +10 deg rotation from the SLTO nominal or 0 deg position. The ADP position is +3 deg.

A full 360 degree sync ring made of AMS 5665 with 12 Teflon support sliders which ride on the strut case OD is used to actuate the EGV LE fan flap. Two existing 3.302 cm (1.300 in.) stroke NASA actuation systems located approximately 180 deg apart as shown in Figures 70 and 71 move the sync ring. No mechanical stops to prevent over rotation of the sync ring (and the damage resulting from vane end contact with the flowpath walls) have been provided. NASA is responsible for setting actuator travel limits to prevent rig damage. Vane rotation will be measured using existing NASA potentiometers mounted as shown in Figure 72.

The EGV ID and splitter are designed to accept the required LE (station 5) and TE (station 6) static pressure instrumentation listed in Table 13 (see Section VII). The fan OD static pressures at the IGV LE and TE are installed in the rotor and diffuser cases, respectively. The core LE ID static pressure taps are designed as intersecting holes in a special "flange" to eliminate the potential interference of routed hypo tubing and the installation of balance weights on the aft flange of the rotor. Provision was also made for routing hypo tubing from the ring ID cavity along the suction surface of the EGV core to the fan side of the splitter and forward and aft to instrumentation stations 5 and 6. Where possible, instrumentation channels were made similar to NASA design practice and large enough to accept 0.157cm (0.062 in.) diameter hypo 6 tubing.

Provision for three spans of core LE Pt/Tt sensors at the centers of equal area are also provided. Channels from the vane LE along the pressure surface to midchord and then radially inward through the ID wall are detailed on the EGV vane case drawings. Five spans of fan flap LE Pt/Tt sensors at the centers of equal areas are detailed on the EGV fan flap instrumentation drawing No. HKJ 3400.

The results of the vibratory and stress analysis for the EGV vane case and LE flap are presented in Section IV. Very low stress levels were predicted for all points analyzed including the flap spindle with a 5 × nominal surge airload condition. The vane case and LE flap vibratory analysis indicated no integral order resonance flutter response or other flow induced instabilities are expected; however, it is recommended that the EGV LE flap be strain gaged and the stress levels monitored during testing because P&WA has no practical experience for accurately verifying the degree of stability of the LE flap configuration.

DISCHARGE DUCTS

The discharge extends from the EGV TE to rig Station 114.839 and consists of those components shown assembled to the EGV in HKJ 3382. The discharge ID, OD and splitter are made of SAE 1010-1030 steel with an AMS 2485 black oxide finish. Instrumentation holes are provided in these components at Stations 6 and 7 as defined by Table 13 of Section VII. The forward end of ID case bolts to the EGV strut case; a 0.025 — 0.041 cm (0.010-0.016 inch) gap exists between the aft end of the ID case and the bearing support structure. Per NASA design practice, this gap was not sealed to prevent rotor discharge leakage from returning to the flowpath upstream of the Station 7 radial probes. The splitter is riveted to the EGV and centered downstream by locating shoulders on the four cross routed instrumentation tubes. The OD case is a welded assembly with 2.032cm (0.800 in.) thick walls to permit the installation of existing NASA circumferential traverse systems, the direct tapping on instrumentation holes and the mounting of actuation system components. To insure correct circumferential alignment when assembling these ducts to the EGV for line drilling the dowel pin, instrumentation tube and Station 7 radial probe holes per HKJ 3382, "Top ℄ " markings are provided instead of offset holes. Two 1.27cm (0.500 in.) diameter threaded holes are provided at the top of the OD case for lifting eyes.

The discharge splitter core side contour was designed to provide constant area flowpaths at instrumentation Stations 6 and 7 and a uniform increase in area without exceeding the 7 degree half-angle for diffusion through to the diffuser. An abrupt change or "dump" in the outer wall of the core flowpath was incorporated aft of Station 7 to control the location of flow separation. The discharge splitter fan side contour provides a constant area flowpath past Stations 6 and 7.

The cross routed instrumentation tubes are each designed to permit the routing of 25 0.165 cm (0.065 in.) diameter hypo tubes from the rig ID and have been aligned with the duct and core side flow to minimize blockage at the aero design point. Plugs were designed for the Station 6 ID

and Station 7 OD and splitter radial discharge probe holes but none were designed for the four circumferential traverse unit slots at Station 6.

Once the EGV and discharge OD, ID and splitter are assembled, line drilled for the instrumentation tubes and radial probes and all the instrumentation installed and routed, it should remain assembled.

DIFFUSER

The diffuser design goal was to provide a uniform increase in core and fan flow area from the discharge exit at rig Station 114.839 (in.) to the existing NASA dual discharge valves and exhaust collector. This was done by contouring the diffuser splitter core side in conjunction with the existing bearing support contour to provide a uniform increase in area through to the core side discharge valve without exceeding the 7-degree half-angle for diffusion. Similar considerations determined the contour of the diffuser splitter fan side and the OD diffuser through to the fan side discharge valve.

The diffuser splitter and the OD diffuser were designed of SAE 1010-1030 steel with a black oxide finish. Two 0.030 cm (0.120 in.) deep channels are provided for routing four core OD and four fan ID flowpath surface static pressure tapes from the discharge instrumentation Station 7 aft along the splitter OD surface and through the exhaust collector wall via hollow bolts as required by NASA design practice. The splitter forward end is notched to locate it radially relative to the discharge splitter. No seal was incorporated to prevent leakage across this interface. The OD diffuser contains no instrumentation.

ACTUATION SYSTEM COMPONENTS

The actuation system mechanical design goals were to: copy the NASA dual actuator concept, use NASA actuators (part No. CF 853171) and rod ends (part No. HKJ3413), minimize the number of new components, and design common parts. These goals were achieved for the IGV core and fan TE flaps and for the EGV LE fan flap as shown in Figure 71. Because of OD case instrumentation and sync ring size considerations, the design of the case and sync ring mount brackets were unique for each variable vane row. The case brackets were made of SAE 1010-1030 and the IGV fan flap sync ring bracket of AISI 410 stainless. The design of the actuator rod end stand-offs was made of AISI 410 stainless for strength and of hex-stock to permit wrenching; a groove/weld scheme was incorporated to permit safety wiring. The motor guides were made of SAE 1010-1030 steel with a black oxide finish and can be formed from 0.48 cm (0.188 in.) flat plate as shown by HKJ 3402.

The two NASA gearmotor/jackscrew actuators located 180 deg apart to drive the variable vane sync rings are rated at 315 Newtons (1400 lbf) each. Their combined 630 Newtons (2800 lbf) is considerable and if sync ring travel is not limited to 4.89, 2.34 and 1.19 cm (1.928, 0.923 and 0.469 inches) for the IGV core, fan and EGV fan flap either mechanically or electronically over rotation will occur and the vane ends will be damaged when driven into the flowpath walls. No mechanical or electrical stops were designed by P&WA and NASA is responsible for incorporating a control/safety feature. The 6.04cm (2.380 inch) stroke actuator was used to vary the IGV fan flap; 3.30 cm (1.300 inch) stroke actuators were used for the IGV core and EGV fan flaps.

POSITION READ OUT COMPONENTS

The design objectives for the position read-out components were to provide dual read-out capability for each vane row with existing NASA potentiometers and a minimum number of new parts. This was achieved with the design of two mounting brackets and three shaft connectors

for the NASA potentiometer assemblies as shown in Figure 72. The mounting brackets are fabricated from 0.480 cm (0.188 in.) thick SAE 1010-1030 plate with a black oxide finish and located 180 deg apart on the rig case for redundant measurements. The connectors for the IGV case flap and the EGV fan flap potentiometers are made from hex-stock to permit wrenching and can be safety wired once installed. The IGV fan flap mounting bracket is a "C" shaped sub-assembly made from 1/16 AISI 410 steel with a machined collar for the potentiometer shaft. The symmetry of the rotor case flange bolt hole patterns to the IGV and EGV airfoil spindles permits relocating the brackets over other vanes should an instrumentation or other consideration create a location conflict. The NASA potentiometer sub-assembly mounting bracket hole pattern was not available and NASA must locate, drill and tap these holes into the six P&WA designed brackets.

SECTION VII
AERODYNAMIC INSTRUMENTATION

The aerodynamic instrumentation summarized in Table 12 was requested by NASA and incorporated with minor exceptions into the mechanical design of the V/STOL fan stage rig. The type of instrumentation and its circumferential, axial and radial location within the core and fan side flowpaths of the rig are presented in Table 13. The instrumentation is listed by instrumentation station from the inlet (Station 1) to the discharge (Station 7) with angular position increasing clockwise (the direction of rotation) when looking aft. Axial position is referenced to the rotor/shaft interface arbitrarily identified as rig location 100.00 (in.). Figure 81 (L238020 sheet 1) includes: a flowpath cross section showing the axial location of instrumentation stations 1 through 7, a roll-out of both the core and fan outer and inner flowpath walls with the circumferential and axial location of all instrumentation noted, axial sections of the rig at instrumentation Stations 1 through 7 depicting the circumferential and spanwise distribution of instrumentation, and recommended static pressure instrumentation installation schemes. The system used to establish the title or "headers" assigned to the instrumentation is also explained in Figure 81. The headers permit identification of: 1) the type of sensor, 2) the axial instrumentation station number, 3) whether it is in the core or fan side flowpath, 4) its circumferential or OD or ID wall position and 5) its radial location relative to the OD wall.

The radial traverse units shown at station 1, the EGV LE instrumentation at Station 5, the circumferential traverse units and the core Pt/Tt radial probes at Station 6, and the fan/core Pt/Tt radial probes at Station 7 are shown in phantom in Figure 81 because they are to be provided by NASA. P&WA drawings detail the machining operations required to incorporate NASA specified instrumentation but the design of probes and instrumentation installation drawings were not contract requirements. Consequently, drawings of plugs are provided for case holes where NASA designed probes are to be used. No plug drawings are provided for the holes machined for existing NASA radial and circumferential traverse systems at Station 1 and 6.

The fan rig inlet instrumentation Station 1 is at axial location 89.530 (in.). It is located 7.315cm (2.88 in.) aft of the rig OD case/plenum (CF847546) interface to provide the 3.810cm (1.500 in.) of upstream clearance required for existing NASA traverse mechanisms. Provision was made for the installation of eight equally spaced OD and ID wall static taps and 4 LC Smith radial traverse units (CD853946). The traverse units are approximately equally spaced circumferentially and mid-gap to the leading edge of the IGV's. The eight OD and ID wall taps are distributed between the traverse units and mid-gap to the IGV's.

The IGV inlet instrumentation Station 2 is located 0.610cm (0.240 inches) forward of the strut LE and due to the 8 deg rearward cant of the IGV spindle centerline is not a radial plane. The 8 OD, 16 splitter and 8 ID wall static taps are at axial stations 91.681, 92.850, and 93.242 (in.), respectively. Four of the eight static pressure taps on each flowpath surface are approximately 90 deg apart and midgap between the IGV leading edges; the remaining four static taps are similarly distributed circumferentially at 10%, 30%, 70% and 90% gap to provide a cross-gap static pressure distribution. To facilitate installation, the 0.051 cm (0.020 in.) diameter static pressure taps in the OD case at station 2 have been drilled at rearward sloping angle to the flowpath of 60 deg. No measurement error is incurred with a 90 deg to 60 deg. installation angle unless the flow direction is reversed, causing a maximum +0.3% q error in Ps.

TABLE 12. — V/STOL MODEL FAN GAGE INSTRUMENTATION SUMMARY

Location and Instrumentation Station #( )		*Instrumentation Location*					
		OD Wall	*OD Splitter*	*ID Splitter*	*ID Wall*	*Fan Flowstream*	*Core Flowstream*
Inlet	(1)	Ps (8)	—	—	Ps (8)	Ps, Pt, Tt, AA Radial Traverse (4)	
IGV LE	(2)	Ps (8)	Ps (8)	Ps (8)	Ps (8)	—	—
IGV TE/R LE	(3)	Ps (8)	Ps (8)	Ps (8)	Ps (8)	—	—
R Tip	(4)	Ps (15)*	—	—	—	—	—
R TE/EGV LE	(5)	Ps (8)	Ps (8)	Ps (8)	Ps (8)	4 vanes each with 5 Pt LE (20) 4 vanes each with 5 Tt LE (20) Sensors at 8.1, 25.3, 43.9, 64.3, and 87.2 span	4 vanes each with 3 Pt LE (12) 4 vanes each with 3 Tt LE (12) Sensors at 15.7, 48.2 and 87.9% span
EGV Exit	(6)	Ps (8)	Ps (8)	Ps (8)	Ps (8)	Ps, Pt, Tt, AA radial/ Circumferential Traverse (4)	4 radial probes with 3 Pt (12) 4 radial probes with 3 Tt (12) Sensors at 15.7, 48.2, and 82.3% span
Diffuser Exit	(7)	Ps (8)	Ps (4)**	Ps (4)**	Ps (4)***	2 radial probes with 5 Pt (10) 2 radial probes with 5 Tt (10) Sensors at 8.2, 25.5, 44.2, 64.6 and 87.4% span	2 radial probes with 3 Pt (6) 2 radial probes with 3 Tt (6) Sensors at 14.7, 46.1, and 80.9% span
R Strain Gages		As described in structures section — no drawing provided for rotor installation modifications					
EGV Strain Gages		As described in structures section — drawing provided for EGV spindle routing hole.					

%Span increases for OD to ID

*Sensors are located from 20% of rotor axial chord upstream of the LE to 20% of rotor axial chord downstream of the TE, at 10% intervals.

**Due to routing limitations, only 4 static pressure taps are provided on these surfaces

***These are existing static taps located on the facility bearing support

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 1	Fan Instrumentation Located Assuming .090" Offset to Strut LE at OD								
Inlet - Ps OD Wall	PS1-Ø1	20.000	98.530	10.073	0	50	NA	NA	NA
	2			52.426					
	3			94.778					
	4			137.131					
	5			179.984					
	6			221.837					
	7			285.376					
	8			327.720					
Ps ID Wall	PS1-I1	6.000	89.530	10.588	100	50	NA	NA	NA
	2			52.941					
	3			95.294					
	4			137.647					
	5			180.000					
	6			222.353					
	7			285.883					
	8			328.235					
Radial Traverse #1 Ps L	PS1TL1	20.000	89.530	73.602	0	50	NA	NA	NA
Ps R	PS1TR1								
AA	AA1T-1								
Pt	PT1T-1								
Tt	TT1T-1								
R	RT1T-1	6.000			100				
Radial Traverse #2 PS L	PS1TL2	20.000	89.530	158.308	0	50	NA	NA	NA
PS R	PS1TR2								
AA	AA1T-2								
Pt	PT1T-2								
Tt	TT1T-2								
R	Rt1T-2								

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 1 (Cont)									
Radial Traverse #3 PS L	PS1TL3	20.000	89.530	243.014	0	50	NA	0	NA
PS R	PS1TR3								
AA	AA1T-3								
Pt	PT1T-3								
Tt	TT1T-3								
R	RT1T-3	6.000			100				
Radial Traverse #4 PS L	PS1TL4	20.000	89.530	348.896	0	50	NA	0	NA
Ps R	PS1TR4								
AA	AA1T-4								
Pt	PT1T-4								
Tt	TT1T-4								
R	RT1T-4	6.000			100				

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 2	Ps Located .250 Forward of IGV LE & LE Circ Offset = .040 @ OD								
IGV LE Ps Fan OD Wall	PS2FØ1	20.000	91.681	31.249	0	50	NA	NA	NA
	2			86.308		10			
	3			137.131		50			
	4			187.955		90			
	5			221.837		50			
	6			259.955		30			
	7			306.543		50			
	8			353.132		70			
Ps Fan ID Wall	PS2FI1	9.340	92.850	31.765	100	50	2	NA	NA
	2			86.824		10	5		
	3			137.647		50	7		
	4			175.765		30	9		
	5			222.353		50	11		
	6			286.941		70	13		
	7			307.059		50	15		
	8			357.882		70	17		
Ps Core OD Wall	PS2CØ1	0.040	92.850	40.235	0	90	2	NA	NA
	2			95.294		50	5		
	3			137.647		70	7		
	4			180.000		50	9		
	5			218.118		30	11		
	6			264.706		50	13		
	7			298.588		10	15		
	8			349.412		50	17		
Ps Core ID Wall	PS2CI1	5.400	93.242	40.235	100	90	NA	NA	NA
	2			95.294		50			
	3			137.647		70			
	4			180.000		50			

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 2 (Cont)									
Ps Core ID Wall	PS2CI5	5.400	93.242	218.118	100	30	NA	NA	NA
	6			264.706		50			
	7			298.588		10			
	8			349.412		50			

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Vane # for Routing	Pitch Angle	Yaw Angle
Station 3	Ps .200	Aft of TE	Projected	Intersection	with OD 12°	Discharge	Angle = .043"	Offset	Circ.
	offset =	.363 or 2.098*	at OD Wall,	or at	splitter &	ID Wall			
IGV/TE Rotor LE PS Fan OD Wall	PS3FØ2	20.000	97.136	34.098	NA	50	NA	NA	NA
	3			89.150		10			
	4			139.973		50			
	5			190.800		90			
	6			224.699		50			
	7			271.267		70			
	8			309.385		50			
	1			8.680		30			
PS Fan ID Wall	PS3FI1	10.046	96.560	31.765	NA	50	2	NA	NA
	2			86.824		10	5		
	3			137.647		50	7		
	4			175.765		30	9		
	5			222.353		50	11		
	6			268.941		70	13		
	7			307.059		50	15		
	8			357.882		90	17		
PS Core OD Wall	PS3CØ1	9.824	96.560	40.235	NA	90	2	NA	NA
	2			95.294		50	5		
	3			137.647		70	7		
	4			180.000		50	9		
	5			218.118		30	11		
	6			264.706		50	13		
	7			298.588		10	15		
	8			349.412		50	17		
PS Core ID Wall	PS3CI1	6.084	96.361	40.235	NA	90	NA	NA	NA
	2			95.294		50			
	3			137.647		70			
	4			180.000		50			

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TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 3 (Cont)									
PS Core ID Wall	PS3CI5	6.084	96.361	218.118	NA	30	NA	NA	NA
	6			264.706		50			
	7			298.588		10			
	8			349.412		50			

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 4									
Rotor Tip Shroud Ps	PS4R-2	20.000	97.323	56.027	0	NA	-20	NA	NA
	PS4R-1		97.487	39.102			-10*		
	PS4R00		97.650	52.177			0		
	01		97.814	35.251			10*		
	02		97.977	48.326			20		
	03		98.141	31.401			30*		
	04		98.304	44.476			40		
	05		98.468	27.551			50*		
	06		98.631	40.626			60*		
	07		98.795	23.700			70*		
	08		98.958	36.776			80		
	09		99.122	19.850			90*		
	10		99.285	32.925			100		
	11		99.449	16.000			110*		
	PS4R12		99.612	29.075			120		

Rotor Stacking Line is at Axial Station 98.595

* Row 1
Row 2 is 1 blade gap circumferential displaced

Ps Taps are in 2 Straight Lines, 26.1743° to Cascade Plane (Tangent to Suction Surface) & 20% of Axial Chord Apart, Extending From 20% Upstream to 20% Downstream

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TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Vane # for Routing	Pitch Angle	Yaw Angle
Station 5									
EGV LE Ps Fan OD Wall	PS5FØ1	20.000	100.476	37.876	0	50	NA	NA	NA
	2			81.455		10			
	3			123.139		50			
	4			168.613		30			
	5			203.402		50			
	6			257.666		70			
	7			293.666		50			
	8			344.823		90			
Ps Fan ID Wall	PS5FI1	11.900	100.476	36.362	100	50	5 LE	NA	NA
	2			79.942		10	10		
	3			121.626		50	14		
	4			167.100		30	19		
	5			206.890		50	23		
	6			256.152		70	28		
	7			292.150		50	32		
	8			343.310		90	37		
Ps Core OD Wall	PS5CØ1	11.696	100.476	37.262	0	90	5 LE	NA	NA
	2			80.840		50	10		
	3			120.630		70	14		
	4			166.104		50	19		
	5			202.104		30	23		
	6			251.367		50	28		
	7			285.472		10	32		
	8			336.630		50	37		
Ps Core ID Wall	PS5CI1	10.080	100.476	37.118	100	90	NA	NA	NA
	2			80.697		50			
	3			120.486		70			
	4			165.960		50			

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Vane #	Pitch Angle From OD Case	Yaw Angle° From Cascade
Station 5 (Cont)	EGV LE Inst, Placed Radially Based on Equal Areas Calculated at the LE. Not .250 Upstream at sensor								
Ps Core ID Wall	PS5CI5	10.080	100.476	201.960	100	30	NA	NA	NA
	6			251.223		50			
	7			285.328		10			
	8			336.486		50			
PT EGV LE Fan	PT5F1A	LE 19.349	100.476	56.842	8.138	HKJ 3400	7	0°	49.35
20.000: OD	B	17.975		Vane ℄	25.313		1	1°	51.90
11.980" ID	C	16.492			43.850			2°	53.50
At LE	D	14.859			64.263			3°	54.75
	E	13.023			87.213			5°	54.40
20.000" OD									
11.900" ID	PT5F3A	LE 19.349	100.476	142.105	8.138	HKJ 3400	16	0°	49.35
At Station 100.476	B	17.975		Vane ℄	25.313			1°	51.90
	C	16.492			43.850			2°	53.50
	D	14.859			64.263			3°	54.75
	E	13.023			87.213			5°	54.40
	PT5F5A	LE 19.349	100.476	227.368	8.138	HKJ 3400	25	0°	49.35
	B	17.975		Vane ℄	25.313			1°	51.90
	C	16.492			43.850			2°	53.50
	D	14.859			64.263			3°	54.75
	E	13.023			87.213			5°	54.40
	PTSF7A	LE 19.349	100.476	312.632	8.138	HKJ 3400	34	0°	49.35
	B	17.975		Vane ℄	25.313			1°	51.90
	C	16.492			43.850			2°	53.50
	D	14.859			64.263			3°	54.75
	E	13.023			87.212			5°	54.40
									OD Wall
									44.39°
									ID Wall
									51.68°

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TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Vane #	Drawing No.	Pitch Angle From OD Case	Yaw Angle° From Cascade
Station 5 (Cont)									
TT EGV LE Fan	TT5F2A	LE 19.349	100.476	75.789	8.138	9	HKJ 3400	0	49.35
	B	17.975		Vane ℄	25.313			1	51.90
	C	16.492			43.850			2	53.50
	D	14.859			64.263			3	54.75
	E	13.023			87.213			5	54.40
	TT5F4A	LE 19.349	100.476	161.053	8.138	18	HKJ 3400	0	49.35
	B	17.975		Vane ℄	25.313			1	51.90
	C	16.492			43.850			2	53.50
	D	14.859			64.263			3	54.75
	E	13.023			87.213			5	54.40
	TT5F6A	LE 19.349	100.476	246.316	8.138	27	HKJ 3400	0	49.35
	B	17.975		Vane ℄	25.313			1	51.90
	C	16.492			43.850			2	53.50
	D	14.854			64.263			3	54.75
	E	13.023			87.213			5	54.40
	TT5F8A	LE 19.349	100.476	331.578	8.138	36	HKJ 3400	0	49.35
	B	17.975		Vane ℄	25.313			1	51.90
	C	16.492			43.850			2	53.50
	D	14.859			64.263			3	54.75
	E	13.023			87.213			5	54.40
									OD Wall
									44.39
									ID Wall
									51.68
PT EGV LE Core	PT5C1F	LE 11.499	100.476	75.789	15.700	9	NA		51.80
11.75 OD	G	10.979		Vane ℄	48.188				53.45
10.15 ID	H	10.434			87.938				51.20
@ LE									

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Vane #	Percent Chord	Pitch Angle	Yaw Angle
Station 5 (Cont)									
PT EGV LE Core	PT5C3F	LE 11.499	100.476	161.053	15.700	18	NA		51.80
11.696 OD	G	10.979		Vane ℄	48.188				53.45
10.080 ID	H	10.434			87.938				51.20
At Station 100.476									
	PT5C5F	LE 11.499	100.476	246.316	15.700	27	NA		51.80
	G	10.979		Vane ℄	48.188				53.45
	H	10.434			87.938				51.20
	PT5C7F	LE 11.499	100.476	331.578	15.700	36	NA		51.80
	G	10.979		Vane ℄	48.188				53.45
	H	10.434			87.938				51.20
TT EGV LE Core	TT5C2F	LE 11.499	100.476	56.842	15.700	7	NA		51.80
	G	10.979		Vane ℄	48.188				53.45
	H	10.434			87.938				51.20
	TT5C4F	LE 11.499	100.476	142.105°	15.700	16	NA		51.80
	G	10.979		Vane ℄	48.188				53.45
	H	10.434			87.938				51.20
	TT5C6F	LE 11.499	100.476	227.368	15.700	25	NA		51.80
	G	10.979		Vane ℄	48.188				53.45
	H	10.434			87.938				51.20
	TT5C8F	LE 11.499	100.476	312.632	15.700	34	NA		51.80
	G	10.979		Vane ℄	48.188				53.45
	H	10.434			87.938				51.20
									OD
									47.40
									ID
									46.31

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Vane # for Routing	Pitch Angle	Yaw Angle
Station 6	Fan instrumentation location based on site at 359.209° & Axial discharge @ OD Wall								
EGV Exit Ps Fan OD Wall	PS6FØ1	20.000	104.630	58.893	0	30	NA	NA	NA
	2			89.209		50			
	3			157.419		70			
	4			174.472		50			
	5			244.578		90			
	6			269.209		50			
	7			331.735		10			
	8			354.472		50			
Ps Fan ID Wall	PS6FI1	12.362	104.630	42.353	100	50	5 TE		
	2			85.932		10	10		
	3			127.617		50	14		
	4			173.090		30	19		
	5			212.880		50	23		
	6			262.143		70	28		
	7			298.142		50	32		
	8			349.300		90	37		
Ps Core OD Wall	PS6CØ1	11.989	104.630	56.294	0	90	5 TE		
	2			99.873		50	10		
	3			139.663		70	14		
	4			185.136		50	19		
	5			221.136		30	23		
	6			270.400		50	28		
	7			304.505		10	32		
	8			355.662		50	37		
PS Core ID Wall	PS6CI1	10.387	104.630	57.928	100	90	NA	NA	NA
	2			101.507		50			
	3			141.296		70			
	4			186.770		50			

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 6 (Cont)									
PS Core ID Wall	PS6CI5	10.387	104.630	222.770	100	30	NA	NA	NA
	6			272.033		50			
	7			315.612		10			
	8			357.296		50			
Radial Probe Pt Probe	PT6C1F	11.737	104.630	27.870	15.730	50	NA	0	20°
11.989 OD	G	11.217	Probe ℄ at		48.190				
10.387 ID	H	10.670	105.180		82.334				
	PT6C3F	11.737	104.630	122.607	15.730	50	NA	0	20°
	G	11.217	Probe ℄		48.190				
	H	10.670	105.180		82.334				
	PT6C5F	11.737	104.630	207.870	15.730	50	NA	0	20°
	G	11.217	Probe ℄		48.190				
	G	10.670	105.180		82.334				
	PT6C7F	11.737	104.630	293.133	15.730	50	NA	0	20°
	G	11.217	Probe ℄		48.190				
	H	10.670	105.180		82.334				
Radial Probe TT Core	TT6C2F	11.737	104.630	75.239	15.730	50	NA	0	20°
11.989 OD	G	11.217	Probe ℄		48.190				
10.387 ID	H	10.670	105.180		82.334				
	TT6C4F	11.737	104.630	160.502	15.730	50	NA	0	20°
	G	11.217	Probe ℄		48.190				
	H	10.670	105.180		82.334				
	TT6C6F	11.737	104.630	245.765	15.730	50	NA	0	20°
	G	11.217	Probe ℄		48.190				
	H	10.670	105.180		82.334				

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 6 (Cont)	Fan Instrumentation Location Based on Site at 0^{o} & Axial Flow								
Radial Probe Tt Core	TT6C8F	11.737	104.630	340.502	15.730	50	NA	0	20^{o}
	G	11.217	Probe ℄		48.190				
	H	10.670	at 105.180		82.334				
Radial/Circ Trav. #1 Ps L	PS6TL1	20.000	104.630	24.00	0	℄ at 0	NA	0	NA
Ps R	PS6TR1		Probe ℄ @	Probe ℄		Traversing			
AA	AA6T-1		104.820			1 ½ Gaps			
PT	PT6T-1					Each			
TT	TT6T-1					Side			
RT	RT6T-1								
CT	CT6T-1	12.362			100				
Radial/Circ Tran #2 Ps L	PS6TL2	20.000	104.630	122.00	0	℄ at 0	NA	0	NA
Ps R	PS6TR2		Probe ℄ at	Probe ℄		Traversing			
AA	AA6T-2		104.820			1 ½ Gaps			
PT	PT6T-2					Each			
TT	TT6T-2					Side			
RT	RT6T-2								
CT	CT6T-2	12.362			100				
Radial/Circ Tran #3 PS L	PS6TL3	20.000	104.630	208.00	0	℄ at 0	NA	0	NA
PS R	PS6TR3		Probe ℄ at	Probe ℄		Traversing			
AA	AA6T-3		104.820			1 ½ Gaps			
PT	PT6T-3					Each			
TT	TT6T-3					Side			
RT	RT6T-3								
CT	CT6T-3	12.362			100				

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description		Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 6 (Cont)										
Radial/Circ Tran #4	PS L	PS6TL4	20.000	104.630	303.00	0	℄ at 0	NA	0°	NA
	PS R	PS6TR4		Probe ℄ at	Probe ℄		Traversing			
	AA	AA6T-4		104.820			1 ⅓ Gaps			
	PT	PT6T-4					Each			
	TT	TT6T-4					Side			
	RT	RT6T-4								
	CT	CT6T-4	12.362			100				

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 7	Fan Instrumentation Location Based on Site at 0^{o} & Axial Flow								
Diffuser Exit PS Fan OD	PS7FØ1	20.000	112.339	17.0	0	NA	NA	NA	NA
	2		(same as	57.0					
	3		℄ of radial	107.0					
	4		PT/TT Probe)	147.0					
	5			197.0					
	6			237.0					
	7			287.0					
	8			327.0					
PS Fan ID	PS7FI1	12.362	113.177	optional	100	NA	NA	NA	NA
	2		0.838"	57.0					
	3		aft of	optional					
	4		radial probe	147.0					
	5		℄	optional					
	6			237.0					
	7			optional					
	8			327.0					
PS Core OD	PS7CØ1	11.000	113.177	optional	0	NA	NA	NA	NA
	2		0.838"	57.0					
	3		aft of	optional					
	4		radial probe	147.0					
	5		℄	optional					
	6			237.0					
	7			optional					
	8			327.0					
PS Core ID	PS7CI1	8.000	112.327	*					
	2			57.0	Existing NASA tap on bearing support				
	3			*					
	4			147.0	Existing NASA tap on bearing support				

"optional"-Routing space thru 2 hollow bolts insufficient for 8 Ps taps on splitter OD & ID surfaces - additional routing space req'd before optional taps can be added - these optional taps are not shown in the instrumentation layout.

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 7 (cont)	Radial Pt/Tt probe sensors located at centers of equal areas (spans on fan, 3 on core)								
Diffuser Exit PS Core ID	PS7CI5	8.000	112.327	*					
	6			237.0	Existing NASA Tap				
	7			*					
	8			327.0	Existing NASA Tap				
Radial Probe #1 Fan	PT7F1A	19.371	112.339	82.0°	8.222	NA	NA	0	0
20.000	B	18.048	Probe ℄		25.516				
12.362 ID	C	16.620			44.183				
	D	15.058	111.800		64.601				
	E	13.312	Sensors		87.412				
Core	PT7C1F	10.559			14.700				30.06°
11.000 OD	G	9.618			46.067				
8.000 ID	H	8.573			80.893				
Radial Probe #2 Fan	TT7F2A	19.371	112.339	172.0°	8.222	NA	NA	0	0
	B	18.048	Probe ℄		25.516				
	C	16.620			44.183				
	D	15.058	111.800		64.601				
	E	13.313	Sensors		87.412				
Core	TT7C2F	10.559			14.700				30.06°
	G	9.618			46.067				
	H	8.573			80.893				
Pt Radial Probe #3 Fan	PT7F3A	19.371	112.339	262.0°	8.222	NA	NA	0	0
	B	18.048	Probe ℄		25.516				
	C	16.620			44.183				
	D	15.058	111.800		64.601				
	E	13.313	Sensors		87.412				
Core	PT7C3F	10.559			14.700				30.06°
	G	9.618			46.067				
	H	8.573			80.893				

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
Station 7 (cont)									
TT Radial Probe #4 Fan	TT7F4A	19.371	112.339	352.0°	8.222	NA	NA	0	0
	B	18.048	Probe ℄		25.416				
	C	16.620			44.183				
	D	15.058	111.800		64.601				
	E	13.312	Sensors		87.412				
Core	TT7C4F	10.559			14.700				30.06°
	G	9.618			46.067				
	H	8.573			80.893				

Radial probes were circumferentially positioned based on existing Ps core ID wall tap locations being duplicated on splitter walls & fan OD & positioning of routing tubes to prevent tube wake impingment affects.

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Percent Gap	Percent Chord	Pitch Angle	Yaw Angle
	Tubes positioned mid way between station 7 Ps wall OD & mid way between station 7 PT/TT rakes								
Cross Bouting Tubes	#1	Fan Side	108.000	27.0^{o}					0^{o}
		Core Side	108.000	27.0^{o}					24.2^{o}
Cross Routing Tubes	#2	Fan Side	108.000	117.00					0^{o}
		Core Side	108.000	117.00					24.2^{o}
Cross Routing Tube	#3	Fan Side	108.000	207.0^{o}					0^{o}
		Core Side	108.00	207.0^{o}					24.2^{o}
Cross Routing Tubes	#4	Fan Side	108.00	297.0					0^{o}
		Core Side	108.00	297.0					24.2^{o}

TABLE 13. — V/STOL MODEL FAN STAGE INSTRUMENTATION LISTING (Continued)

Instrumentation Type/Description	Title	Sensor Diameter (in.)	Axial Location	Circ. Location	Percent Span	Airfoil #	Percent Chord	Pitch Angle	Yaw Angle
Rotor Strain Gage	SR 1A					1	80		
	2A						50		
	3A						50		
	1B					7	80		
	2B						50		
	3B						50		
	1C					13	80		
	2C						50		
	3C						50		
	1D					19	80		
	2D						50		
	3D						50		
EGV Strain Gage	SE 4A			104.210°		12			
	4B			274.737°		30			

Figure 81. NASA V/STOL Model Fan Stage Rig — Instrumentation

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The IGV exit/rotor inlet instrumentation Station 3 is located approximately midway between the IGV fan and core flap trailing edges and the rotor leading edge and is therefore not a radial plane. The 8 OD, 16 splitter and 8 ID wall static taps are at axial Stations 97.136, 96.560 and 96.361 (in.), respectively; and distributed similarly to those at the IGV LE. This placement scheme is used for static pressure taps at all airfoil leading and trailing edge instrumentation stations. The eight splitter ID and eight splitter OD wall static taps at both the IGV LE (Station 2) and the IGV TE (Station 3) are routed along the splitter OD wall in pairs, through the splitter in groups of four and along the pressure surface of the IGV core strut to the rig ID. The IGV and splitter channels into which the hypo tubing for 32 static pressure taps must be buried have been made to permit routing the 32 splitter taps and the 24 core ID wall taps from Stations 1, 2, and 3 into the plenum through flange notches and holes provided in the forward ID flowpath duct and the slip ring tube support assembly. NASA is responsible for the design and fabrication of any umbilical system to route these lines out of the plenum and for grinding routing notches into strut assembly CR846186 as shown in L237442-sheet 4.

Instrumentation Station 4 consists of 15 static pressure taps distributed axially over the blade tip from 20% rotor axial chord upstream to 20% downstream. These taps are in two rows at the blade tip section chord angle and spaced one blade tip gap apart as shown in section J-J and detail X of Figure 81. The percent axial chord location of each tap is designated by the last two spaces of the header, i.e., -2 denotes 20% upstream from the rotor LE, 02 denotes 20% downstream from the LE and 12 denotes 120% downstream from the LE.

The rotor exit/EGV inlet instrumentation Station 5 is located 0.635 cm (0.250 in.) upstream of the EGV LE at axial station 100.476 (in.). Eight static pressure taps are provided on the fan OD, fan ID, core OD and core ID walls and are distributed relative to the EGV LE as previously described. The fan ID and core OD or splitter wall taps must be routed through channels machined into the fan side of the splitter and the EGV suction surface to the rig ID, then aft and through the four cross routing instrumentation tubes. Once instrumented, the EGV, OD and ID cases and the discharge splitter can remain assembled as a unit during rig assembly and teardown. Also routed through the four cross-over tubes is the core LE Pt (vanes #7, 16, 25 & 34) and LE Tt (vanes No 9, 18, 27 and 36) instrumentation (T4060685); i.e., three spans of sensors are provided on 4 pairs of equally spaced vanes for a total of 12 Pt and 12 Tt sensors. The Pt/Tt sensors are radially positioned at centers of equal areas at 15.7, 48.9, 64.3, and 87.2% span for a total of 20 Pts and 20 Tts. This LE instrumentation is routed out of the flowpath through channels in the flap pressure surface and spindle. A drawing (HKJ3400) detailing machining, kiel head design and Pt/Tt installation has been provided.

The EGV exit instrumentation Station 6 is at axial location 104.630 (in.) or approximately one chord length downstream of the EGV TE. It was originally requested that this instrumentation station be within a half chord length of the EGV TE but to do this required mounting the EGV LE flap sync ring forward of the spindle, thus eliminating the on-stand removable rotor tip shroud design feature. The four fan duct circumferential/radial traverse units (CF852670) located at axial station 104.820 (in.) are uniformly distributed circumferentially and centered at 0% gap relative to the EGV TE for an axial discharge flow condition. The 27.3 deg arc travel of the traverse units will permit the mapping of approximately 2.9 vane gaps in each quadrant of the fan discharge. Eight fan OD static pressure taps located between the traverse units provide the typical gapwise distribution. The eight fan ID wall taps are similarly distributed for an axial discharge flow condition but more uniformly spaced circumferentially. The eight core OD wall taps are located circumferentially near the fan ID splitter taps so they can be routed in pairs along the splitter and the EGV core side suction surface to the rig ID. This scheme minimizes the instrumentation machining required. The eight core ID wall taps at Station 6 are circumferentially located opposite the OD wall taps, providing the typical gapwise distribution for the 20 deg discharge flow condition. Eight equally spaced 3.175 cm (1.250 in.) dia. holes in the core ID wall have been provided for the installation of 4 Pt and 4 Tt radial

probes. The probe hole centerline is axially 1.397 cm (0.550 in.) aft of instrumentation Station 6 so that the three radial sensors located at centers of equal area as listed in Table 13 will be on approximately the same discharge plane as the wall statics. The eight holes are circumferentially located to place the sensors at midgap to the EGV TE for a 20 deg discharge flow condition. Hole plugs (HKJ3375) which can be used in the fabrication of the probes have been detailed by P&WA. NASA is responsible for the probe design and fabrication. If the eight probes are 0.318 cm (0.125 in.) wide and 1.778 cm (0.700 in.) long they will produce approximately 2.4% blockage in the core discharge.

The four tubes at axial location 108.00 (in.) are for routing instrumentation from the rig ID to the rig OD. Each is designed to accept 25 0.165 cm (0.065 in.) dia. instrumentation lines. If the instrumentation scheme of Figure 81 is followed, each tube will carry 18 static pressures and 6 TC's. These 0.686 cm (0.270 in.) wide tubes detailed by P&WA (HKJ3374), contribute 3.14 and 2.12% blockage to the core and fan duct flow area when aligned at the flow discharge angle shown.

The rig discharge instrumentation Station 7 is at axial location 112.339 (in.); approximately 6.350 cm (2.500 in.) forward of the rig/housing support interface (HKJ3371) as requested by NASA. Four equally spaced sets of holes through the OD case and the splitter have been provided for the installation of two Pt and two Tt radial probes. Plugs detailed by P&WA for these holes (HKJ3377 and HKJ3376) may be incorporated into the NASA probe design. The probe configuration shown in phantom in Figure 81 and listed in Table 13 provides five spans of sensors for the fan duct and three spans of sensors for the core duct. The 16 Pt and 16 Tt sensors are located at the center of equal areas and the core side probe shaft was aligned to account for flow discharge angle change with discharge area increase. Four 0.51 cm (0.200 in.) wide probes will produce 2.5% and 1.6% blockage of the core and fan duct discharge areas, respectively. Four existing core ID wall static taps located circumferentially at 57, 147, 237, and 327 deg, and axially at location 112.327 (in.) have been used. Four core OD and fan ID static pressure taps at the same circumferential locations have likewise been incorporated to take advantage of the routing scheme used by NASA. The use of 8 static taps on the splitter walls as originally requested would have exceeded the capacity of the existing routing scheme and required facility modification. Placement of the splitter static taps at axial location 113.177 (in.) or 2.129 cm (0.838 in.) aft of the radial probe centerline was necessary to permit line drilling for the station 7 radial probes and disassembly of the EGV and discharge ducts as a subassembly without disconnecting discharge instrumentation as explained in the rig design considerations of Section V.

No provision was made for the installation of rotor strain gages. Recommended locations are presented in Section IV. A drawing detailing the spindle hole required for routing strain gages to the suction surface of the EGV LE fan flap (HKJ3397) is provided. No strain gage installation was considered necessary for the integrally machined IGV and EGV case struts or the IGV core and fan flaps.

SECTION VIII
FABRICATION

The purpose of this section of the design report is to provide the information required to fabricate the NASA LeRC V/STOL fan rig since the P&WA fabrication effort (Phase III) was terminated on 7 January 1983.

SPECIFICATIONS

The reference information required to support the fabrication and assembly of the rig, i.e., standard parts, materials specifications, manufacturing processes and drawing interpretations was provided in a separate volume (Reference 5) delivered to NASA LeRC on 3 May 1983. The information available in this volume is listed in Tables 14 through 17.

TABLE 14. — PARTS

Part Number	*Layout*	*Item*	*Remarks*
AN 123629	L237442	31	
AS 3066-12		87	
AS 3068-10		68	
AS 3168		70	Sub for MS 9111-20
HKJ 1655		3	IGV Raw Matl
HKJ 1656		11	EGV Raw Matl
HKJ 2515	L237441		Rotor Forging
HKJ 3413	L237442	40	Heim Rod End Assy
MS 9111-20		90	
MS 9226-05		42	Safety Wire
MS 9276-10,-12	54, 55		
MS 9361-10,-12	52, 53		
MS 9386-023		78	
MS 9390-430		18	
MS 9565-08,		69	
MS 9566-08,-11,-12,-14	57, 86, 46, 58		
MS 9568-06		88	
MS 9724		90	Sub for MS 9111-20
MS 9942-26,-32	56, 60		
MS 18064-13		89	
MS 122030		70	
MS 35338		56	Sub for MS 122030 & 32
MS 51023		89	Sub for MS 18064-13
MS 51038		51	
MS 122032		56	
MS 645231	L237441	3	
MS 645232	L237441	5	
MS 641619		93	Sub for MS 9390-430
MS 761787	L237441	4	
MS 4022587	L237442	43	
MS 4027818		32	

TABLE 15. — MATERIALS

AMS No.	*PWA No.*	*AISI No.*	*Other*
3651			Teflon
4117			6061-T6 A1
4973	1202	8.1.1.	
5060			SAE 1015
5069			SAE 1018
5070			SAE 1022
5504			
5510			
5599			
5613		410	
5616			
5646		347	
5663			
5665			
5666			
5731			
5735			
5737			
6322			
7232			
7240			
7267			

TABLE 16. — PROCESSES

Spec No.	*Title*
AMS 2470	Anodic Treatment of Aluminum Alloys
AMS 2485	Black Oxide Treatment
PWA 6	Peening
PWA 11-15,-22	Heat Treatments
PWA 16-1,-2	Welding
PWA 19	Gold Nickel Alloy Braze
PWA 85	Silver Metal Braze
PWA 99	Surface Finishing of Holes
PWA 106	Grinding of Titanium and Titanium Alloys
PWA 255	Plasma Spraying (METCO 601)
PWA 310	Identification Marking
PWA 357	Rivets
PWA 362-1	Surface Texture
PWA 706	Brazing Filler Material

TABLE 17. — DRAWING INTERPRETATIONS

PWA Spec	*Title*
DRM 14.13.1	Dimensions for Installation of Dowel Pins
DRM 15.1.1	Balancing of Rotating Parts
PWA 330	Drawing Interpretation for Airfoils
PWA 360	Drawing Interpretations
PWA 390	Computer File Airfoil Section Coordinate Data and Fairing Procedures

ESTIMATED COST

An estimated cost or hours to fabricate column is provided in Tables 18 through 25. This estimate is based on: vendor quotes for the IGV and EGV and the rotor bladed disk, vendor costs for similar components escalated for inflation and factored for complexity, and estimates of P&WA shop hours required to fabricate those components for which no comparable part cost history is available. No P&WA labor or overhead rates were applied and no factors for quality control, tooling, etc, were included. Separate cost-to-fabricate estimates are provided for the slipring/inlet cases, IGV sub assembly, rotor and split case, EGV sub assembly, discharge/diffuser splitter and cases and the actuation/position indicating components in Tables 18 through 25. These tables include part name and number of units required and recommended units purchased, material and vendor quote (if applicable) and may be used as a format for recording fabrication costs.

C. PROCURED HARDWARE

Hardware procured in support of the fabrication effort prior to the 7 January 1983 termination notice and delivered to NASA LeRC on 2 February 1983, is listed in Table 26. Rotor balance weights (Part Numbers 645231, 645232 and 761787) were to be provided from P&WA stores but termination prevented their purchase and delivery.

The AMS4973 (PWA1202/8.1.1 titanium) rotor forging composition and mechanical properties as determined by the Ladish Company were submitted to NASA LeRC on 5 April 1983 for review. Composition was as required with the exception of aluminum which exceeded the 8.35% maximum by 0.17%. Mechanical properties were within specification and are compared to the required properties in Table 27. The AMS5616 rings for the IGV and EGV strut cases were supplied by L&B Engineering. L&B will provide lab test results if requested; the rings were accepted by the P&WA materials control lab as adequate for experimental but not flight use.

The following were P&WA considerations for designing specific rig components and planning for their fabrication. Those vendors listed for particular machining operations are P&WA source approved and have been found to be reliable and cost competitive.

RECOMMENDED VENDORS

IGV and EGV Strut Cases and Rotor Blisk

The IGV and EGV strut cases and the rotor blisk were designed to be integrally machined for cost savings. The one-piece construction is less costly than individual components when purchasing only one unit because there are fewer machined surfaces, less inspection time, no welding/assembly tooling required and no assembly. In addition, dimensional control is improved and the flowpath is continuous. Risk however, increases and care must be taken during all phases of fabrication and assembly to prevent machining errors and damage due to handling. No extra rotor forgings or IGV/EGV steel rings were purchased for scrap allowance due to their high per unit cost — \$23K and \$6K, respectively. P&WA source approved vendors capable of manufacturing these components include:

Atlas Tool Inc.
29880 Goresback Ave.
Roseville, Michigan 48066
(313)778-3570

Contura, Inc.
12411 Old Highway 99 N
P.O. Box 769
(314)232-8858

Atlas tools uses numerically controlled machines that require airfoil coordinate tapes provided by P&WA. Contura uses a pantograph/hand machining operation and tooling simulating all airfoil passage contours.

IGV Core Flap and IGV/EGV Fan Flaps

These airfoils are conventional in design and require no unusual machining operations with the exception of the 22.86 cm (9.000 in.) long 0.65cm (0.256 in.) diameter hole through the IGV fan flap and spindle for the IGV core flap spindle. This configuration has not been required for any P&WA airfoils. However, if a hole straight within the required tolerances is drilled first and the airfoil machined relative to it, no fabrication problems should arise. Vendors with P&WA source approval and capable of manufacturing conventional airfoils include:

Jarco Machine Products
P.O. Box 10
4373 Lilburn Industrial Way
Lilburn, Georgia 30247
(404)921-5902

Jarvis Airfoils
10 Glastonbury Turnpike
Portland, Conn. 06480
(203)342-3800

Mal Tool & Engineering
291 Adams St.
Manchester, Conn. 06040
(203)643-2473

New England Aircraft Products
P.O. Box 83
Spring Lane
Farmington, Conn. 06032
(203)677-1377

TRW Inc.
Compressor Components Division
P.O. Box 400
Route 11 Woodbine Lane
Danville, PA 17821
(717)271-7509

Instrumentation

The instrumentation channels required in the IGV and EGV strut cases, the IGV LE and TE splitter, the EGV TE splitter and the EGV fan flap can be made by electrical discharge machining (EDM). Qualified vendors include:

Electro Form Machining
P.O. Box 8927
12095 N.W. 39th St.
Coral Springs, Fla. 33065
(305)755-2700

EDM Precision Products
5650 N.W. 9th Ave.
Ft. Lauderdale, Fla. 33309
(305)771-1555

Installation of the EGV LE Pt/Tt instrumentation and fabrication of the EGV core discharge and diffuser exit Pt/Tt radial probes can be done by:

H&B Tool & Engineers
P.O. Box 717
481 Sullivan Ave.
South Windsor, Conn. 06074
(203)528-9341

Projects Inc.
P.O. Box 174
38 Addison Road
Glastonbury, Conn. 06033
(203)633-4615

Rotor Tip Shroud

The Metco 601 (PWA 255) rotor tip shroud material has been successfully installed on P&WA rigs by:

Quantum Inc.
Barns Industrial Park
Wallingford, Conn. 06492
(203)265-2811

General Plasma Assoc.
12 Thompson Road
East Windsor, Conn. 06002
(203)623-9901

Other

The remaining rig components require no special expertise to fabricate other than the ability to meet tight concentricity, flatness, and dimensional tolerances. Qualified vendors include:

Dexter Aero Space
34260 James J. Pompo Dr.
Fraser, Michigan 48020
(313)296-2611

Caval Tool & Machine Co. Inc.
P.O. Box 11158
275 Richard St.
Newington, Conn. 06111
(203)666-8414

TABLE 18. — NASA LeRC V/STOL MODEL FAN STAGE RIG INLET CASES AND SLIP RING SUPPORT

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
Fwd Case-OD-Assy	20	1	1	5613	HKJ 3373							$4949.40	
Case	21	-	-										
Fwd Flange	22	-	-										
Aft Flange	23	-	-										
Washer	56		34		MS 122032							$55.08	Joins 20 to 1
Bolt	57		34	5731	MS 9566-08							$28.56	"
Fwd Case-ID-Assy	24	1	1	Alum	HKJ 3378							$2839.50	
Case	25	-	-										
Fwd Flange	26	-	-										
Aft Flange	27	-	-										
IGV/ID Case Washers	56	8	10		MS 122032							$16.20	Joins 24 to 1
" " " Bolts	57	8	10	5731	MS 9566-08							$8.40	"
Slip Ring Spacer	38	1	1		HKJ 3398							$621.76	Make from CF 851447
SlipRing Supp. Assy	74	1	1		HKJ 3379							$2855.84	
Tube	75	-	-										
Flange	76	-	-										
Split Coupler-Left	113	1	1		HKJ 3380-1							$250 matl + 25 hrs	
-Right	114	1	1		HKJ 3380-2							$250 matl + 25 hrs	
Bolts(tube to coupler)	58	4	6		MS 9566-14							6.78	
Washer " " "	56	4	6		MS 122032							9.72	
Dowel Pins	93	4	6		641619							29.34	
Bolts(coupler splitline)	58	14	18		MS 9566-14							20.34	
Nuts " "	68	14	18		AS 3068-10							146.70	
Spacer	115	1	1		HKJ 3381							250.00	
Bolts-coupler to strut	79	4	-		NASA T/P							40.00	
Bolts - slipring	51	8	12		MS51038-D3							12.00	
Bolts-strut to ID	95	4	-		NASA T/P							40.00	
										Total		$12,429.62 + 50 hrs.	

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TABLE 19. — NASA LeRC V/STOL MODEL FAN STAGE RIG INLET GUIDE VANE ASSEMBLY

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
IGV Assy	2	-			T4060675							$47,500.00	Vendor Quote PEC16038
IGV Strut Assy	3	1	1	5616	T4060676	91631	5475.00				L&B		
IGV OD Case Rear	4	1	1	5613	T4060677								
IGV ID Case Rear	5	1	1	5613	T4060678								
IGV TE Splitter	6	1	1	5504	T4060679							$2900.00	Vendor Quote PEC16040
IGV LE Splitter	7	1	1	5504	T4060680							$1170.00	
IGV Fan Flap	8	17	20	5613	T4060682							$8806.00	Vendor Quote PEC16041
IGV Core Flap	9	17	20	5504	T4060681							$9010.00	
Dowel Pins	18	2		5735	641619							$9.78	
[illegible]													
Sync Ring-Flap	29	1	1	4115	HKJ 3387							$409.31 matl + 268 hrs	
Pin-Sync Arm-Core	35	17	24		HKJ 3389							$87.12	
Sync Arm-Fan	32	17	20	5599	HKJ 3395							$4000.00	Make from 4022587
Slider-Sync Ring	30	8+8	16	teflon	HKJ 3384							$298.40	Insert for items 29&41
Pin-SyncArm-Fan	36	17	24	5662	HKJ 3388							$176.05	
Sync Ring-Core	41	1	1	4115	HKJ 3385							$409.31 matl + 26.8 hrs	
Rivets	31	16	24		AN123629							$17.11	Joins items 3, 6, & 7
Sync Arm-Core	43	17	20	5599	HKJ 3394							$4000.00	Make from 4022587
Bearing (teflon)	44	17+17	40	teflon								$388.80	
Inst. Machining												$6000.00	
Nut	52	17	20		MS 9361-10							$47.40	
Nut	53	17	20		MS 9361-12							$70.80	
Tabwasher	54	17	20	5510	MS 9276-10							$28.98	
Tabwasher	55	17	20	5510	MS 9276-12							$30.59	
Bolt	56	8										$31.64	
Washer	59	8										$203.56	
Bushing (SST)	47	17	20									$83. matl	
Lockwasher	56	17	40		MS 122032							$64.80	Joins items 4 & 3
Bolt	60	17	20	6322	MS 9942-32							$145.20	Joins items 4 & 3
Bolt	57	17	20	5731	MS 9566-08							$16.80	Joins items 47 & 4
													Joins items 47 & 4
											Total	$85,904.65 + 65 hrs	

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TABLE 20. — NASA LeRC V/STOL MODEL FAN STAGE RIG ROTOR, ROTOR CASE AND TIP SHROUD INSERT

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
Rotor Assy	1	-										40,404.00	Vendor Quote PEC15526
Blisk	2	-	1	1202	T4060023	91870	22410.		40K		Atlas		R/M PNHKJ2515&1654A
Counternut Assy	3	-											in house
Counternut	4	AR	12	SST	645231				$70.			218.09	
Counternut	5	AR	12	SST	645232				$750.			1105.32	
Counternut	6	AR	12	SST	761787				$70			218.09	
Rotor Case-Assy	15	-	-		HKJ 3368							3244.58 matl + 4 hrs	
Split Case-(LH)	16	1	1	5613									
Split Case-(RH)	17	1	1	5613									
Dowel Pins	18	4	6	5735	MS9390-430							18.84	
Split Tip Shroud Inserts	19	1 set	1 set	5613	HKJ 3369							3244.58 matl + 2 hrs	
Lockwasher EGV	56	38	42		MS 122032							68.04	Joins 4 to 16 to 12
Bolt EGV	57	38	42	5731	MS 9566-08				.81@			35.28	"
Lockwasher	56	10	12		MS 122032							19.44	
Bolt-Split Line	46	10	12	5731	MS 9566-12							29.97	Joins split case items
Nut-split line bolt	68	10	12		AS 3067-10							111.67	16
Bolt-Rotor Shroud to case	69	28	32		MS 9565-08							51.58	Joins 19 to 16
Lockwasher	70	28	32		MS 122030							25.92	Joins 19 to 16
Lockwasher IGV	56	34	40		MS 122032							64.80	
Bolt IGV	58	34	40		MS 9566-14							158.40	
Nut	68	34	40		AS 3068-10							372.40	
											Total	$49,391.00 + 285.6 hrs	

TABLE 21. — NASA LeRC V/STOL MODEL FAN STAGE RIG EXIT GUIDE VANE ASSEMBLY

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
EGV Assy	10	-			T4060683							37,629.46	Vendor Quote PEC16039
EGV Strut Assy	11	1	1	5616	T4060684	91632	5475				L&B		
EGV OD Case Fwd	12	1	1	5613	T4060685								
EGV Splitter-Rear	13	1	1	5504	HKJ 3365							2000. matl + 95.2 hrs	
EGV Flap-Fan	14	38	42	5504	T4060686							17220.00	Vendor Quote PEC16042
Dowel Pins	18	2	4	5735	MS9390-430							12.56	
Slider(teflon)	30	12	16	teflon	HKJ 3384							298.43	
Pin-Sync arm to ring	35	38	42	5662	HKJ 3389							308.08	
Sync Ring	37	1	1	4115	HKJ 3386							409.31 matl + 53.6 hrs	
Sync Arm	39	38	42	5599	HKJ 3396							8400.00	Make from 4022587
Bearing (teflon)	48	38	48	teflon	HKJ 3392							790.56	
Bushing (SST)	49	38	42	5613	HKJ 3393							1090.74 matl + 126 hrs	
Rivets	31	12	18		AN 123629							12.18	
Lockwasher Case	56	38	42		MS 122032							68.04	Joins 49 & 11
Bolt Case	57	38	42	5731	MS 9566-08				.81@			35.28	"
Bearing (teflon)	50	38	48		HKJ 3383							790.56	
Lockwasher split	56	38	42		MS 122032							68.04	Joins 11 & 12
Bolt split	57	38	42	5731	MS 9566-08				.81@			35.28	
Inst. Machining												6000.00	
Tablock spindle	55	38	42		MS 9276-12							39.90	
Nut spindle	53	38	42		MS 9361-12							148.76	
MOOS of item 14													
LE PT Inst Core	28	4	4									2024.96	
LE TT Inst Core	28	4	4									3118.80	
SG Inst Fan	33	2	2		HKJ 3397							965.02	
LE PT Inst Fan	28	4	4		HKJ 3400							6115.79	
LE TT Inst Fan	28	4	4		HKJ 3400							4314.62	
										Total		$91,897.02 + 274.8 hrs	

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TABLE 22. — NASA LeRC V/STOL MODEL FAN STAGE RIG DISCHARGE AND DIFFUSER DUCTS

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
OD Aft Case-Assy	61	1	1	5613	HKJ 3366							11542.74	
OD Case	62	-	-										
Fwd Flange	63	-	-										
Aft Flange	64	-	-										
Lockwasher	56	38	40		MS 122032							64.80	Joins 61 to 10
Bolt	57	38	40	5731	MS 9566-08				.81@			35.28	"
Bolt	83	-	-		NASA T/P							———	Joins 61 to facility
Lockwasher	84	-	-		NASA T/P							———	"
O Ring	78	4	12		MS9386-023							9.48	
Disch Probe ID Boss	117	4	8		HKJ 3376							37.68 matl + 64.8 hrs	
Bolt	57	16	18		MS 9566-08							15.88	
ID Aft Case	65	1	1	5613	HKJ 3367							947.99 matl + 142.8 hrs	
Lockwasher	56	8	10		MS 122032							16.20	
Bolt	57	8	10	5731	MS 9566-08				.81@			8.82	
EGV Disch ID Boss	116	4	8		HKJ 3375							600.00	
Bolts	57	16	18		MS 9566-08							15.88	
Exhaust splitter Assy	71	1	1	alum.	HKJ 3370							17112.00	
Duct	72	-	-										
Spacer	73												
Mount Plate	67	1	1		HKJ 3371							2479.16	Make from CD 846194
Bolt	80	-	-		NASA T/P							———	Joins 71 to facility
Lockwasher	81	-	-		NASA T/P							———	"
OD Exhaust Duct	77	1	1	alum.	HKJ 3372							5555.88	
Lockwasher	81	-	-		NASA T/P							———	Joins 77 to facility
Bolt	82	-	-		NASA T/P							———	"

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TABLE 22. — NASA LeRC V/STOL MODEL FAN STAGE RIG DISCHARGE AND DIFFUSER DUCTS (Continued)

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
Routing Tube-Assy	119	4	4		HKJ 3374							4827.60	
OD Boss	120	-	-										4 for probes, 4 as plugs
ID Boss	124	-	-										
Splitter Boss	122	-	-										
Fan Tube	123	-	-										
Core Tube	121	-	-										
Bolts	57	16	18		MS 9566-08							15.81	
"O" Rings	78	8	12		MS9386-023							9.48	
										Total		$43,705.40 + 288.40 hrs	

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TABLE 23. — NASA LeRC V/STOL MODEL FAN STAGE RIG CORE ACTUATION/POSITION READOUT COMPONENTS

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
Bolts	86	4	6		MS 9566-11							12.54	Actuator Brkt.to case
Bracket	96	2	2		HKJ 3408							7.76 matl & 14.7 hrs	
Coupling	40	4	4		HKJ 3413							30.00	
Hex Post	94	4	4		HKJ 3406							29.40 matl & 14.8 hrs	
Motor Guide	91	2	2		HKJ 3402							49.25 matl & 11.2 hrs	
Nut	87	4	4		AS 3066-12							10.00	
Safety Wire	as required				MS 9226-05							1.98	
Set Screw	89	2	4		MS18064-13							8.60	
Vane/Pot Connector	100	2	2		HKJ 3410							7.35 matl & 8.8 hrs	
Brkt. Assy	102	2	2		HKJ 3411							7.76 matl & 14.7 hrs	
Bolt	86	4	5		MS 9566-11							10.45	
Washer	56	4	5		MS 122032							8.10	
										Total		$ 203.19 & 64.2 hrs	

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TABLE 24. — NASA LeRC V/STOL MODEL FAN STAGE RIG IGV FLAP ACTUATION/POSITION READOUT COMPONENTS

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
Bolts	88	4	6	5731	MS 9568-06							46.00	
Nut	87	4	6	5737	AS 3066-12							15.00	
Bolts	90	4	6	5731	MS 9111-20							31.75	
Rod Ends	40	4	4		HKJ 3413							50.00	
Case Brkt.	97	2	2		HKJ 3401								
Hex Pin-Short	45	2	2		HKJ 3407							14.7 matl & 11.7 hrs	
Hex Pin-Long	94	2	2		HKJ 3406							14.70 matl & 11.7 hrs	
Motor Guide Brkt	91	2	2		HKJ 3402							49.25 matl & 11.2 hrs	
Sync Ring Brkt	66	2	2		HKJ 3399							18.44 matl & 14.3 hrs	
Safety Wire	as required				MS 9226-05							1.98	
												7.76 matl & 14.7 hrs	
Brkt Assy	102	2	2		HKJ 3411								
													HKJ 3404 HKJ 3405
Coupler Assy	104	2	2		HKJ 3403							30.61 matl & 24.1 hrs	Item 105 Item 106
Bolts	86	4	6	5731	MS 9566-11							12.54	
Washer	56	4	6		MS 122032							9.72	
Set Screw	89	2	4	300 SST	MS18064-13							8.60	
											Total	$339.03 & 87.7 hrs	

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TABLE 25. — NASA LeRC V/STOL MODEL FAN STAGE RIG EGV FLAP ACTUATION/POSITION READOUT COMPONENTS

Name Description	Item No.	UPE	Units Req'd (min)	Mat'l (AMS)	Part No.	Raw Mat'l PO	Raw Mat'l Cost	Fab PO	Fab Cost	Fab Status	Vendor	Estimated Vendor Cost or Hours to Fabricate	Remarks
Motor Guide	91	2	2		HKJ 3402							49.25 matl & 11.2 hrs	
Case Brkt	92	2	2		HKJ 3414							69.96 matl & 27.3 hrs	
Hex Pin-Long	94	2	2		HKJ 3406							14.70 matl & 11.7 hrs	
Hex Pin-Short	45	2	2		HKJ 3407							14.70 matl & 11.7 hrs	
Bolts	88	4	6	5731	MS 9568-06							46.01	
Nut	87	4	6	5737	AS 3066-12							15.00	
Rod End	40	4	4		HKJ 3413							50.00	
Vane/Pot Connector	101	2	2		HKJ 3412							7.35 matl & 8.8 hrs	
Set Screw	89	2	4	300 SST	MS18064-13							8.60	
Pot Brkt Assy	109	2	2		HKJ 3409							16.58 matl & 10.0 hrs	
	110	-	-										
	111	-	-										
Lockwasher	56	4	6		MS 122032							9.72	
Bolt	86	4	6		MS 9566-11							12.54	
Safety Wire	as required				MS 9226-05							1.98	
											Total	$316.39 matl & 80.7 hrs	

TABLE 26. — DELIVERED HARDWARE

Part number	*Quantity delivered*	*Component description*	*Part number to be fabricated*
HKJ2515	1	AMS973 Forging for Integral Rotor	4060023
HKJ1655	1	AMS5616 Ring for IGV Strut Case	T4060676
HKJ1656	1	AMS5616 Ring for EGV Strut Case	T4060684
4022587	84	Sync Arms - IGV Core/EGV Fan Flap	HKJ3395/3396
4027818	35	Spherical Bearings - IGV Fan Flap Sync Arm	HKJ3395

TABLE 27. — ROTOR FORGING MECHANICAL PROPERTIES AMS 4973

Material Property	*Test Location*	*Required Property*	*Tested Property*
Tensile Test - Room Temp			
0.2% Yield Strength	11 2	83K newtons/cm^2(120 Kpsi) min	90K newtons/cm^2(130 Kpsi)
Ultimate Strength	11 2	90K newtons/cm^2(130 Kpsi) min	104K newtons/cm^2(151 Kpsi)
% Elongation	11 2	10 min	18
% Reduction of Area	11 2	20 min	44
Tensile Test — 427°C(800°F)			
0.2% Yield Strength	21 2	48K newtons/cm^2(70 Kpsi) min	59K newtons/cm^2(85 Kpsi)
Ultimate Strength	21 2	62K newtons/cm^2(90 Kpsi) min	74K newtons/cm^2 (108 Kpsi)
% Elongation	21 2	10 min	22
% Reduction of Area	21 2	25 min	65
V Notch Stress Rupture	51 2	103K newtons/cm^2 (150 Kpsi) for 5 hrs	103K newtons/cm^2 (150 Kpsi) after 5.1 hrs
Creep Rupture Test at 454°C(850°F), 28K newtons/cm^2 (40 Kpsi)	71 2	0.10% at 22 hrs	0.09% at 23 hrs

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SECTION IX
ASSEMBLY

The general assembly sequence for the IGV and the EGV/discharge ducts and installation of the overall V/STOL model fan stage rig into the Lewis Research Centers W-8 test cell as shown in Figure 82 are presented in this section. The rig was designed to require no special tooling, and the assembly sequence presented herein is to explain the engineering philosophy of the rig design. The IGV and EGV flaps were dimensionally toleranced to nominal and therefore require hand fitting at assembly. This approach was taken to minimize endwall gaps.

INLET GUIDE VANE (IGV)

The IGV assembly includes installation of the fan and core TE flaps, the aft OD and ID cases, the splitter leading and trailing edges and the station 2 and 3 static pressure instrumentation. The components required for the IGV assembly should be machined for instrumentation but whether or not the IGV strut case is partially instrumented prior to initiating the component fitting procedure presented below is at the discretion of the assembler. It is important to remember that once the TE splitter is riveted into place, the core flap cannot be removed or installed.

1. Serialize the IGV core flaps (T4060682) 1 through 17 and install in the IGV case splitter holes at the corresponding vane locations.

2. Install the aft ID shroud (T4060678) with 3 bolts (MS9942-26). Note the circumferential location of the instrumentation and metal stamp "Top ℄ " to facilitate reassembly.

3. The core flap should rotate ± 20 degrees freely and have some radial movement — 0.010 to 0.023 cm (0.004 to 0.009 in.).

4. Load each flap toward the ID and rotate through the range of travel. There should be 0.005 cm (0.002 in.) clearance between the vane end and the ID wall at the closest approach. If necessary, remove vane end material until 0.005 cm (0.002 in.) clearance is achieved to insure a no-rub assembled condition.

5. Align instrumentation channels and temporarily install the TE splitter (T4060679). Do not rivet.

6. Repeat step 4 loading the core flap toward the OD. This completes the core flap fitting.

7. Serialize the IGV fan flaps (T4060681) 1 through 17 and install the corresponding serial number steel bushing (HKJ3391) with the Teflon thrust bearings (HKJ33480). If rotation of the spindle within the bearings is stiff, enlarge the bearing ID.

8. Install the corresponding serial number sync arm (HKJ3395), tablock washer (MS9276-12) and spindle nut (MS9361-12). Torque the nut to spec but do not bend the tablock. Measure and record the thrust bearing to sync arm gap (radial movement). If there is no radial movement and

rotation is again stiff, the required alteration will be explained in steps 11c and 11d.

9. Slide the fan flap sub assemblies over the core flap spindles and bolt (MS9566-08) the steel bushings (HKJ3391) to the IGV case (T4060676). Torque to specification.

10. Install the aft case (T4060677) with 3 bolts (MS9942-32). Metal stamp "Top ℄ " to facilitate reassembly.

11. Check the fan flaps for the required rotation (+20 deg to −60 deg, −20 deg is nominal, i.e., the sync arm is axial). Flap ends should clear the flowpath walls by 0.005 cm (0.002 in.) at the closest approach when radially loaded in the direction of the gap being measured.

    (a) If the spindle/bushing subassembly has radial movement 0.003 to 0.015 cm (0.001 to 0.006 in.) as measured in step 8, remove material from the OD flaps end until the required clearance is achieved during rotation.

    (b) Repeat step 11a loading the flap toward the ID.

    (c) If the spindle/bushing subassembly had no radial movement and touches the ID wall, remove material from the surface of the Teflon thrust bearing nearest the flap platform until some radial movement is possible (0.003 to 0.015 cm/0.001 to 0.006 in.). Reassemble. If the flap end still contacts the ID wall when loaded radially inward, remove material from the flap end until the required 0.005 cm (0.002 in.) clearance is achieved. Then load the flap toward the OD and remove material from the flap end until clearance is achieved.

    (d) If the spindle/bushing subassembly had no radial movement and touches the OD wall, proceed as in step 11c but remove material from the surface of the Teflon thrust bearing nearest the sync arm.

    (e) If the spindle/bushing subassembly has radial movement and flap end touches both the OD and ID walls, remove material from both ends until the required clearance is achieved.

    (f) If the spindle/bushing subassembly has no radial movement and touches both the OD and ID walls, remove material from the end of the Teflon thrust bearing nearest the sync arm until radial movement is achieved and then proceed as in step 11e.

12. When the core and fan flap ends clear the walls and rotate freely, remove the nut, tablock and sync arm from the fan flap spindle.

13. Press the Teflon sliders (HKJ3384) into the sync ring (HKJ3387) and trial fit the sync ring assembly onto the IGV case (T4060676). If rotation is stiff,

reduce the slider thickness as required. Maintain concentricity between the case and the sync ring (0.114 cm/0.045 in.) is the nominal gap.

14. Install sync arm pins (HKJ3388) and reinstall the fan sync arms, tablocks, and nuts. Torque to specification. Do not bend the tablock. Check for sync ring freedom of travel through the +20 deg to −60 deg rotation.

15. Repeat steps 13 and 14 for IGV core flap with items HKJ3384, HKJ3389, HKJ3385, HKJ3394, MS9361-10 and MS9276-10. Sync arm rotation is ±20 degrees from axial. When smooth continuous rotation is possible, the core flap fitting procedure is complete.

16. Install the remaining ID and OD aft case bolts (MS9942-26 and -32) and torque to specification. Recheck clearances and travels.

17. If the station 2 and 3 static pressure hypo tubing is partially installed, the TE splitter (T4060679) could be permanently riveted (AN123629) into place at this time per HKJ3415. However, if core flap disassembly is necessary for any reason prior to test, do not rivet the TE splitter.

18. The LE splitter (T4060680) could also be riveted (AN123629) at this time (HKJ3415). However, its permanent addition further limits access to the core strut where hypo tubing may have to be installed.

EXIT GUIDE VANE (EGV)/DISCHARGE DUCT ASSEMBLY

The EGV/discharge duct assembly includes temporary installation of the TE splitter, OD and ID cases for line drilling, fitting of the LE fan flap, disassembly for instrumentation installation and reassembly. All instrumentation machining but no sensor installation should be completed prior to initiating this assembly sequence.

1. Temporarily install the TE splitter (HKJ3365) to the EGV case (T4060684). Use rivets (AN123629) to align the close tolerance holes but do not flare the rivets.

2. Install aft OD and ID cases (HKJ3366 and HKJ3367). Check axial stack up of components per HKJ3382. Machine for dowel pins (641619) and insert. Line drill for cross routing instrumentation tubes and station 7 discharge probes per HKJ3382.

3. Remove aft OD and ID cases and the TE splitter and initiate LE fan flap fitting procedure.

4. Serialize the EGV flaps (T4060686, HKJ3400, and HKJ3397) with strut location as required per L238020 sheet 2 (Figure 82).

5. Install the corresponding serial number steel bushings (HKJ3393) with the teflon thrust bearings (HKJ3392 and HKJ3383). If rotation of the spindle within the Teflon bearings is stiff, enlarge the bearing ID.

6. Install the corresponding numbered sync arms (HKJ3396). Install tablock (MS9276-12) and nut (MS9361-12). Torque to spec but do not bend tablock. Measure and record the thrust bearing to sync arm gap (radial

movement). If there is no radial movement and rotation is now stiff, the required alteration will be explained in step 8.

7. Place the EGV flap subassemblies into their respective locations in the EGV core and install the forward OD case (T4060685) with 3 equally spaced bolts (MS9566-08). Torque to specification.

8. Check the LE flap for ± 10 degrees of rotation. The flap ends should clear the flowpath walls by 0.010cm (0.004 in.) at the closest approach; if not, follow the fitting procedure presented for the IGV in steps 11a through 11f.

9. When all flap ends clear the flowpath walls through maximum rotation, remove the nut (MS9361-12) and tablock (MS9276-12) from the flap spindle.

10. Press the Teflon sliders (HKJ3384) into the sync ring (HKJ3386) and trial fit the assembly to the EGV case (T4060684). If rotation is stiff, reduce the slider thickness as required. Maintain concentricity between the case and the sync ring (0.114 cm/0.045 in. is the nominal gap).

11. Install the sync arm pins (HKJ3389) and reinstall the sync arms, tablock washers and nuts. Torque the nut to specification but do not bend the tablock. Recheck for sync ring freedom of travel. Install the remaining OD case bolts (MS9566-08) and torque to specification. Recheck clearance and travel.

12. This completes the flap fitting sequence. Disassemble the EGV. Install the LE fan flap and core Pt and Tt sensors. Install the station 5 wall static taps and route the Station 6 hypo tubing to the case/splitter interface.

13. Install the TE splitter (HKJ3365) with rivets (AN123629). Complete the routing and installation of the Station 6 wall static taps.

14. Reinstall the LE fan flaps and reassemble through installation of the sync ring. Do not bend tablock.

15. Install aft OD and ID cases (HKJ3366 and HKJ3367) with bolts (MS9566-08), align with dowel pins, torque to specification.

16. Install hole plugs (HKJ3375) or NASA provided core discharge probes and the cross-routing instrumentation tubes (HKJ3374) with "0" rings (MS9386-023) and route the ID instrumentation lines through to the case OD. This completes the IGV/discharge duct assembly.

RIG ASSEMBLY/FACILITY INSTALLATION

Rig assembly and installation into the NASA LeRC W-8 test facility is outlined below. The axial locations of component interfaces that must be inspected during assembly to insure adequate rotor clearances are listed in Table 28 and shown in Figures 80 and 83.

1. Move the plenum to the maximum forward position to provide approximately 51cm (20 inches) assembly clearance between face 0 and face F of Figure 83.

2. Install the rear housing support (HKJ3371), the OD diffuser (HKJ3372) and the diffuser splitter (HKJ3370). Verify that the axial distance from face 0 to face W is within tolerance. If it is not, measure EGV/discharge assembly dimension from face R to face W and modify as required to achieve the required face R to face 0 assembled dimension.

3. Install the EGV/discharge assembly over the bearing compartment/shaft support and bolt into place.

4. Measure the axial distance from face O to face Q and from face O to face R. If these dimensions are not within tolerance, running clearance between the rotor and the EGV ID and splitter and between the rotor and the IGV ID and splitter will not be correct and a rub could occur. Modify as required to achieve the required dimensions. This completes the installation of the EGV/discharge duct assembly and the diffuser ducts.

5. Modify the plenum strut assembly to accept instrumentation lines (L237442 sheet 4).

6. Install spacer CF851588 (0.838 cm/0.330 in. thickness) and the ID forward case (HKJ3378). Measure the axial distance from face G to face F (CF847546) as defined in Figure 83. If not as required, do not modify spacer CF851588 until step 7.

7. Install the OD forward case (HKJ3373) and measure the axial distance from face G to face H (Figure 83). If this distance is not 2.068 ±0.005cm (0.814 ± 0.002 in.), remove spacer CF851588 and modify as required.

8. Install the IGV assembly with bolts (MS9566-08 both OD and ID bolt circles). Measure the axial distance from face L to face J. If this dimension is not within tolerance, running clearance between the rotor and the IGV ID and splitter will not be correct and a rub could occur. Modify as required to achieve the required dimensions.

9. Route ID instrumentation forward into the plenum through the holes and notches provided. Secure as necessary to prevent damage during installation of the slip ring support tube.

10. Install the balanced rotor assembly (4060073 with balance weights 645232, 761787 and 645231 as required), slip ring spacer (HKJ3398) and coupling (CC848383) with tiebolts provided by NASA. Measure the axial gap between the rotor and the EGV ID and splitter as shown in Figure 80. These distances must be as required or a rub condition will exist during rotation.

11. Mount the slip ring within the support tube (HKJ3379) with set screws (MS1038-103). Axial placement of the slip ring within the tube is to be determined by NASA. Insert this assembly through the center of the plenum. Do not install the spacer (HKJ3381) or the tube support halves (HKJ3380-1, -2) at this time.

12. Slide the slip ring/tube support assembly forward and attach to the rotor. If necessary, bring the plenum aft to permit couplings.

13. Install 1/2 of the rotor case assembly (HKJ3369 installed within HKJ3368-1 with bolts MS9565-08) to the EGV case (T4060685) with 6 bolts (MS9566-08). Torque to specification.

CAUTION

> Care must be taken during this operation or the slip ring/coupling can be damaged. (Care must also be taken during disassembly.)

14. Slowly move the plenum aft against the rotor case half installed in step 13. As the plenum is moved aft, the slip ring support tube must be pulled into the plenum.

15. Attach the rotor shroud to the IGV case with 6 bolts (MS9566-08). Torque to specification. Measure the axial gap between the rotor and the IGV ID and splitter as shown in Figure 80. These distances must be as required or a rub condition will exist during rotation.

16. Measure the blade tip to tip shroud gap as shown in Figure 80. This distance must be 0.96cm (0.038 in.) to maintain 0.051 cm (0.020 in.) running clearance at 17762 rpm.

17. If all clearances are as required, loosen the rotor shroud to EGV and IGV case bolts installed in step 13 and 15 and install the remaining 1/2 of the rotor case assembly (HKJ3369 installed within HKJ3368-2). Install all split line bolts (MS9566-2) and nuts (AS3068-10) and torque to specification. Install and torque to specification all EGV and IGV to rotor case bolts. This completes the basic IGV-rotor case-EGV/discharge assembly.

18. Measure the axial distance between face C and face A. Grind the spacer (HKJ3381) to achieve this dimensional stack-up when assembled with the tube support halves (HKJ3380-1, -2).

19. Install spacer (HKJ3381) and the tube support halves (HKJ3380-1, -2) as shown in Figure 82 to fixture the slip ring support tube (HKJ3379) in place. Route instrumentation lines through the notches provided. Torque all bolts (MS9566-14 and AS3068-10) to specification.

20. The instrumentation (L238020 sheet 1), the actuation systems (L237442 sheet 2), and the vane angle potentiometers (L237442 sheet 3) are now installed. This completes the V/STOL fan stage rig assembly.

Figure 82. NASA V/STOL Model Fan Stage Rig — Assembly

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TABLE 28. — AXIAL LOCATION OF V/STOL FAN STAGE RIG COMPONENT INTERFACES

Station/ Face	*Interface Description*	*Nominal Axial Location (Inches)*
A	Forward End-Slip Ring Tube Support	54.139
B	Tube Support Aft End/Spacer (2.540cm/1.000 inch)	62.639
C	Spacer/Plenum Strut Assembly	63.639
D	Plenum Strut Assy/Spacer CF51588 (0.838cm/0.330 inch)	74.699
E	NASA Spacer/Inlet ID Case Forward End	75.029
F	Facility/Inlet OD Case	86.649
G	Inlet ID Case/IGV Forward ID Case	91.342
H	Inlet OD Case/IGV Forward OD Case	92.156
I	Slip Ring Support Tube Aft End	93.139
J	IGV Aft OD Case/Rotor Case	96.236
K	Slip Ring/Slip Ring Spacer (0.991cm/0.390 inch)	96.800
L	IGV Aft ID Face	96.966
M	Rotor Forward ID Flowpath Face	96.986
N	Rotor/Slit Ring Spacer	97.190
0	Rotor/Shaft Interface	100.000
P	Rotor Aft ID Flowpath Face	100.203
Q	EGV Forward ID Face	100.233
R	Rotor Case/EGV Forward OD Case	100.971
S	EGV Aft OD Case/OD Discharge Case	102.451
T	EGV ID Case/ID Discharge Case	102.471
U	EGV Splitter/Discharge Splitter (Aft Face)	103.751
V	Discharge Splitter/Diffuser Splitter	113.005
W	OD Discharge Case/Aft Mount Flange	114.839
X	Aft Mount Flange/OD Diffuser	115.959
Y	Aft End of OD Diffuser	123.550
Z	Diffuser Splitter/Housing Support	132.895

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FIGURE VIII-1

Figure 83. NASA V/STOL Model Fan Stage Rig — Assembly Inspection Stations

FD 265650

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APPENDIX A
AIRFOIL AERODYNAMIC DESIGN SUMMARIES

The column headings, postscripts and superscripts for the airfoil aerodynamic design summaries for the V/STOL rig IGV, Rotor and Stator (EGV) are identified below.

SL	Streamline identification number 1-11, ID to OD
V	Absolute Velocity
VM	Meridional Component of Absolute Velocity
VO	Tangential Component of Absolute Velocity
U	Wheel Speed (See Note)
RHOVM	Product of Static Density and Meridional Velocity
EPSI	Streamline Slope Measured from Engine Axis
PO/PO	Total Pressure Ratio, TE to Inlet
TO/TO	Total Temperature Ratio, TE to Inlet
B	Air Angle Relative to Axial Direction
M	Mach Number
DIA LE	Leading Edge Diameter
DIA TE	Trailing Edge Diameter
D FAC	Diffusion Factor
OMEGA-B	Loss Coefficient
LOSS-P	Total Pressure Loss of Dynamic Head Rise
PO2/PO1	Total Pressure Ratio, TE to LE
% EFF A	Percent Adiabatic Efficiency — Total
% EFF P	Percent Polytropic Efficiency — Total
PCT TE	Percent Span at Trailing Edge
WC1/A1	Inlet Specific Flow
NCORR	Corrected Speed
WCORR	Corrected Flow

Postscripts: 1 Leading Edge
2 Trailing Edge

Superscripts: ′ Relative to Rotor

Note: Wheel speed is calculated assuming rotor is present at leading and trailing edges. U = 0 for stators.

4105C

TABLE 29. — INLET GUIDE VANE — NOMINAL TAKEOFF ID STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	VO-1 M/SEC	VO-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	VO'-1 M/SEC	VO'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	PO/PO INLET
1	160.9	135.2	160.9	135.1	0.0	2.3	127.6	129.9	205.3	185.9	-127.6	-127.6	175.82	151.91	-0.0216	0.1674	0.9942
2	162.6	140.8	162.6	140.8	0.0	2.4	136.2	139.2	212.1	196.3	-136.2	-136.8	177.23	157.18	-0.0131	0.1750	0.9943
3	164.3	146.1	164.3	146.1	0.0	2.5	144.8	148.6	219.0	206.6	-144.8	-146.1	178.58	162.01	-0.0059	0.1806	0.9943
4	165.8	151.0	165.8	151.0	0.0	2.6	153.4	157.9	225.9	216.6	-153.4	-155.3	179.87	166.35	-0.0002	0.1842	0.9943
5	167.3	155.5	167.3	155.5	0.0	2.7	162.0	167.2	232.9	226.4	-162.0	-164.6	181.06	170.23	0.0042	0.1862	0.9942
6	168.7	159.6	168.7	159.6	0.0	2.7	170.7	176.6	239.9	236.0	-170.7	-173.8	182.17	173.69	0.0074	0.1870	0.9941
7	169.9	163.4	169.9	163.4	0.0	2.8	179.3	185.9	247.0	245.4	-179.3	-183.1	183.17	176.79	0.0097	0.1870	0.9940
8	171.1	166.8	171.1	166.8	0.0	2.9	187.9	195.2	254.1	254.6	-187.9	-192.4	184.06	179.52	0.0110	0.1867	0.9938
9	172.1	169.9	172.1	169.9	0.0	2.9	196.5	204.6	261.2	263.7	-196.5	-201.6	184.85	181.95	0.0117	0.1861	0.9937
10	172.9	172.6	172.9	172.6	0.0	3.0	205.1	213.9	268.3	272.6	-205.1	-210.9	185.54	184.09	0.0116	0.1855	0.9935
11	173.7	175.1	173.7	175.1	0.0	3.0	213.8	223.2	275.4	281.3	-213.8	-220.2	186.11	185.95	0.0111	0.1848	0.9934

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	PO2/ PO1	%EFF-A TOTAL	%EFF-P TOTAL
1	0.0	1.0	38.40	43.75	0.4838	0.4035	0.6173	0.5549	13.716	13.970	5.400	5.500	0.1640	0.0389	0.0075	0.9942	0.0	0.0
2	0.0	1.0	39.93	44.60	0.4891	0.4211	0.6379	0.5870	14.643	14.973	5.765	5.895	0.1375	0.0380	0.0074	0.9943	0.0	0.0
3	0.0	1.0	41.38	45.44	0.4943	0.4375	0.6589	0.6186	15.570	15.977	6.130	6.290	0.1136	0.0371	0.0072	0.9943	0.0	0.0
4	0.0	1.0	42.75	46.26	0.4992	0.4528	0.6801	0.6494	16.497	16.980	6.495	6.685	0.0925	0.0364	0.0071	0.9943	0.0	0.0
5	0.0	1.0	44.05	47.08	0.5039	0.4668	0.7015	0.6796	17.424	17.983	6.860	7.080	0.0738	0.0362	0.0071	0.9942	0.0	0.0
6	0.0	1.0	45.29	47.90	0.5082	0.4797	0.7230	0.7092	18.351	18.987	7.225	7.475	0.0572	0.0363	0.0071	0.9941	0.0	0.0
7	0.0	1.0	46.49	48.71	0.5122	0.4916	0.7446	0.7382	19.278	19.990	7.590	7.870	0.0424	0.0366	0.0072	0.9940	0.0	0.0
8	0.0	1.0	47.63	49.51	0.5158	0.5023	0.7662	0.7667	20.205	20.993	7.955	8.265	0.0292	0.0372	0.0073	0.9938	0.0	0.0
9	0.0	1.0	48.74	50.32	0.5190	0.5121	0.7879	0.7947	21.133	21.996	8.320	8.660	0.0174	0.0377	0.0074	0.9937	0.0	0.0
10	0.0	1.0	49.80	51.12	0.5217	0.5208	0.8095	0.8222	22.060	23.000	8.685	9.055	0.0068	0.0382	0.0075	0.9935	0.0	0.0
11	0.0	1.0	50.83	51.92	0.5241	0.5286	0.8312	0.8493	22.987	24.003	9.050	9.450	-0.0026	0.0386	0.0075	0.9934	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	VO-1 FT/SEC	VO-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	VO'-1 FT/SEC	VO'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	528.0	443.4	528.0	443.4	0.0	7.6	418.5	426.2	673.7	609.8	-418.5	-418.6	36.01	31.11	-1.240	9.590	0.0000
2	533.5	462.1	533.5	462.0	0.0	7.9	446.8	456.9	695.9	644.2	-446.8	-448.9	36.30	32.19	-0.751	10.026	0.1000
3	538.9	479.5	538.9	479.4	0.0	8.2	475.1	487.5	718.4	677.9	-475.1	-479.2	36.58	33.18	-0.340	10.350	0.2000
4	544.1	495.5	544.1	495.5	0.0	8.5	503.4	518.1	741.2	710.8	-503.4	-509.6	36.84	34.07	-0.011	10.556	0.3000
5	548.9	510.3	548.9	510.2	0.0	8.8	531.6	548.7	764.2	742.9	-531.6	-539.9	37.08	34.86	0.241	10.669	0.4000
6	553.4	523.8	553.4	523.7	0.0	9.0	559.9	579.3	787.3	774.3	-559.9	-570.3	37.31	35.57	0.426	10.714	0.5000
7	557.5	536.1	557.5	536.1	0.0	9.2	588.2	609.9	810.5	805.1	-588.2	-600.7	37.51	36.21	0.555	10.717	0.6000
8	561.2	547.3	561.2	547.2	0.0	9.4	616.5	640.5	833.7	835.3	-616.5	-631.1	37.70	36.77	0.633	10.696	0.7000
9	564.5	557.4	564.5	557.3	0.0	9.6	644.8	671.1	857.0	865.1	-644.8	-661.6	37.86	37.27	0.668	10.663	0.8000
10	567.4	566.5	567.4	566.4	0.0	9.7	673.1	701.8	880.3	894.3	-673.1	-692.0	38.00	37.70	0.667	10.626	0.9000
11	569.8	574.5	569.8	574.4	0.0	9.9	701.4	732.4	903.7	923.0	-701.4	-722.5	38.12	38.08	0.638	10.588	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	TO/TO INLET	PO/PO INLET	EFF-AD INLET %	EFF-P INLET %	TO2/TO1	PO2/PO1	EFF-AD ROTOR %	EFF-P ROTOR %
36.57	178.56	1.0000	0.9940	0.0	0.0	0.0	0.9940	0.0	0.0

TABLE 30. — ROTOR ONE — NOMINAL TAKEOFF ID STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	P0/P0 INLET	T0/T0 INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-1 RADIAN	EPSI-2 RADIAN
1	170.7	325.7	170.6	215.2	1.8	244.5	182.68	250.10	1.7171	1.1924	86.79	87.75	0.4131	0.3300
2	172.4	318.0	172.4	224.9	2.0	224.8	184.02	266.30	1.7031	1.1799	91.34	91.97	0.3906	0.3134
3	174.1	311.0	174.1	228.8	2.1	210.6	185.35	274.54	1.6862	1.1713	93.97	94.39	0.3694	0.2978
4	175.7	304.8	175.7	230.2	2.2	199.7	186.59	279.29	1.6714	1.1651	95.74	96.03	0.3494	0.2831
5	177.2	300.0	177.2	229.6	2.3	193.0	187.71	280.68	1.6607	1.1621	96.19	96.45	0.3306	0.2693
6	178.5	295.6	178.5	228.1	2.4	188.1	188.68	280.62	1.6513	1.1604	96.03	96.30	0.3128	0.2561
7	179.7	291.6	179.7	226.4	2.5	183.7	189.52	280.12	1.6425	1.1592	95.69	95.98	0.2960	0.2437
8	180.6	288.1	180.6	222.9	2.6	182.6	190.20	276.46	1.6344	1.1607	93.78	94.19	0.2801	0.2318
9	181.4	284.5	181.4	218.1	2.7	182.7	190.75	270.89	1.6245	1.1632	91.09	91.68	0.2652	0.2206
10	182.0	280.8	182.0	210.9	2.7	185.3	191.15	261.58	1.6125	1.1682	86.97	87.81	0.2511	0.2100
11	182.4	272.7	182.4	192.3	2.8	193.3	191.40	236.12	1.5761	1.1781	77.91	79.28	0.2385	0.2000

SL	B-1 DEGREE	B-2 DEGREE	M-1	M-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D-FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	P0/P0 STAGE	T0/T0 STAGE	%EFF-A TOT-STG	%EFF-P TOT-STG
1	0.6	47.2	0.5145	0.9525	17.780	24.638	7.000	9.700	0.2990	0.2702	0.0324	1.7271	0.0	0.0	0.0	0.0
2	0.6	43.6	0.5200	0.9321	18.593	25.080	7.320	9.874	0.2674	0.1533	0.0202	1.7129	0.0	0.0	0.0	0.0
3	0.7	41.4	0.5254	0.9118	19.406	25.522	7.640	10.048	0.2587	0.0909	0.0128	1.6958	0.0	0.0	0.0	0.0
4	0.7	39.8	0.5306	0.8936	20.218	25.964	7.960	10.222	0.2586	0.0531	0.0079	1.6810	0.0	0.0	0.0	0.0
5	0.7	39.1	0.5353	0.8785	21.031	26.406	8.280	10.396	0.2692	0.0418	0.0064	1.6705	0.0	0.0	0.0	0.0
6	0.8	38.7	0.5396	0.8646	21.844	26.848	8.600	10.570	0.2827	0.0414	0.0066	1.6611	0.0	0.0	0.0	0.0
7	0.8	38.3	0.5433	0.8516	22.657	27.290	8.920	10.744	0.2953	0.0436	0.0072	1.6526	0.0	0.0	0.0	0.0
8	0.8	38.7	0.5464	0.8395	23.470	27.732	9.240	10.918	0.3183	0.0685	0.0115	1.6447	0.0	0.0	0.0	0.0
9	0.8	39.5	0.5489	0.8265	24.282	28.174	9.560	11.092	0.3454	0.1029	0.0175	1.6350	0.0	0.0	0.0	0.0
10	0.9	41.0	0.5507	0.8122	25.095	28.616	9.880	11.266	0.3832	0.1566	0.0267	1.6230	0.0	0.0	0.0	0.0
11	0.9	44.9	0.5519	0.7822	25.908	29.058	10.200	11.440	0.4649	0.2785	0.0456	1.5866	0.0	0.0	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	PCT TE SPAN	T0/T0 INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-1 DEGREE	EPSI-2 DEGREE
1	559.9	1068.5	559.9	705.9	6.0	802.1	37.41	51.22	0.0000	1.1924	86.79	87.75	23.667	18.906
2	565.5	1043.4	565.5	737.9	6.5	737.7	37.69	54.54	0.1000	1.1799	91.34	91.97	22.379	17.954
3	571.2	1020.3	571.1	750.6	6.9	691.1	37.96	56.23	0.2000	1.1713	93.97	94.39	21.164	17.063
4	576.5	1000.1	576.4	755.4	7.3	655.4	38.22	57.20	0.3000	1.1651	95.74	96.03	20.020	16.223
5	581.4	984.2	581.3	753.3	7.7	633.4	38.44	57.49	0.4000	1.1621	96.19	96.45	18.941	15.429
6	585.7	969.9	585.7	748.4	8.0	617.0	38.64	57.47	0.5000	1.1604	96.03	96.30	17.924	14.676
7	589.5	956.7	589.4	743.0	8.3	602.7	38.82	57.37	0.6000	1.1592	95.69	95.98	16.962	13.961
8	592.7	945.4	592.6	731.3	8.5	599.2	38.96	56.62	0.7000	1.1607	93.78	94.19	16.051	13.283
9	595.3	933.5	595.2	715.6	8.7	599.4	39.07	55.48	0.8000	1.1632	91.09	91.68	15.192	12.639
10	597.2	921.2	597.1	692.0	8.9	608.1	39.15	53.57	0.9000	1.1682	86.97	87.81	14.388	12.030
11	598.4	894.7	598.3	631.0	9.1	634.4	39.20	48.36	1.0000	1.1781	77.91	79.28	13.663	11.461

NCORR INLET RPM	WCORR INLET LBM/SEC	WCORR INLET KG/SEC	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T0/T0 STAGE	P02/P01	P0/P0 STAGE	EFF-AD STAGE %	EFF-P STAGE %
17761.70	10.53	4.78	1.1670	1.6518	92.29	92.82	0.0	1.6619	1.6518	0.0	0.0

TABLE 31. — STATOR ONE — NOMINAL TAKEOFF ID STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	VO-1 M/SEC	VO-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	VO'-1 M/SEC	VO'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	PO/PO INLET
1	338.2	201.7	244.6	189.6	233.6	69.0	239.8	245.7	244.7	259.2	-6.1	-176.7	274.26	254.09	0.2316	0.0308	1.5189
2	329.9	218.8	250.4	205.6	214.8	74.8	243.5	249.4	252.0	269.8	-28.7	-174.6	286.80	282.61	0.2202	0.0312	1.5878
3	322.1	224.4	251.2	210.9	201.6	76.7	247.3	253.2	255.3	275.0	-45.7	-176.5	292.33	293.99	0.2099	0.0310	1.6164
4	315.2	226.5	250.3	212.8	191.6	77.4	251.1	257.0	257.3	278.4	-59.5	-179.6	295.17	299.63	0.2004	0.0305	1.6314
5	309.7	225.5	247.7	211.9	185.8	77.1	254.9	260.8	257.2	280.4	-69.0	-183.7	295.13	299.62	0.1918	0.0299	1.6324
6	304.5	222.6	244.6	209.2	181.4	76.1	258.6	264.6	256.5	281.5	-77.2	-188.5	293.99	296.28	0.1838	0.0294	1.6250
7	299.7	219.5	241.4	206.3	177.6	75.1	262.4	268.3	255.9	282.7	-84.9	-193.3	292.49	292.57	0.1764	0.0290	1.6168
8	295.4	214.2	236.5	201.3	177.0	73.2	266.2	272.1	252.8	283.0	-89.2	-198.9	288.03	284.45	0.1696	0.0288	1.5987
9	291.0	205.1	230.7	192.7	177.4	70.1	270.0	275.9	248.6	281.9	-92.6	-205.8	281.97	270.55	0.1633	0.0288	1.5673
10	286.5	191.5	222.7	180.0	180.3	65.5	273.8	279.7	241.5	279.8	-93.5	-214.2	272.35	249.77	0.1577	0.0294	1.5236
11	278.1	162.5	204.7	152.8	188.2	55.6	277.5	283.5	223.4	274.3	-89.3	-227.9	248.30	207.26	0.1528	0.0308	1.4406

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	%EFF-A TOTAL	%EFF-P TOTAL
1	44.4	20.0	1.47	42.93	0.9964	0.5598	0.7207	0.7192	25.781	26.416	10.150	10.400	0.5046	0.2458	0.0382	0.8845	66.88	88.69
2	41.3	20.0	6.70	40.29	0.9735	0.6142	0.7438	0.7572	26.187	26.822	10.310	10.560	0.4260	0.1478	0.0243	0.9325	79.75	93.08
3	39.3	20.0	10.52	39.8[illegible]	0.9505	0.6335	0.7535	0.7764	26.594	27.229	10.470	10.720	0.3858	0.0920	0.0155	0.9593	87.23	95.58
4	37.9	20.0	13.60	40.11	0.9296	0.6417	0.7586	0.7890	27.000	27.635	10.630	10.880	0.3592	0.0538	0.0092	0.9770	92.41	97.28
5	37.3	20.0	15.82	40.87	0.9116	0.6395	0.7571	0.7953	27.407	28.042	10.790	11.040	0.3479	0.0390	0.0067	0.9838	94.07	97.58
6	37.0	20.0	17.77	41.97	0.8948	0.6310	0.7537	0.7982	27.813	28.448	10.950	11.200	0.3449	0.0371	0.0063	0.9850	94.11	97.41
7	36.7	20.0	19.61	43.08	0.8788	0.6221	0.7504	0.8011	28.219	28.854	11.110	11.360	0.3435	0.0373	0.0064	0.9853	93.79	97.07
8	37.1	20.0	20.89	44.61	0.8638	0.6053	0.7391	0.7996	28.626	29.261	11.270	11.520	0.3546	0.0546	0.0092	0.9791	90.33	95.00
9	37.9	20.0	22.09	46.83	0.8480	0.5770	0.7244	0.7933	29.032	29.667	11.430	11.680	0.3806	0.0915	0.0150	0.9658	84.68	92.36
10	39.3	20.0	22.98	49.92	0.8311	0.5353	0.7006	0.7821	29.439	30.074	11.590	11.840	0.4261	0.1470	0.0230	0.9469	76.89	88.18
11	42.9	20.0	23.77	56.12	0.7997	0.4490	0.6423	0.7578	29.845	30.480	11.750	12.000	0.5304	0.2501	0.0344	0.9140	62.88	80.43

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	VO-1 FT/SEC	VO-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	VO'-1 FT/SEC	VO'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	1109.7	661.9	802.5	622.0	766.5	226.3	786.6	806.0	802.7	850.3	-20.1	-579.7	56.17	52.04	13.272	1.763	0.0000
2	1082.4	718.0	821.5	674.7	704.7	245.5	799.0	818.4	826.9	885.1	-94.3	-572.9	58.74	57.88	12.615	1.786	0.1000
3	1056.8	736.2	824.3	691.9	661.4	251.7	811.4	830.8	837.8	902.2	-150.0	-579.1	59.87	60.21	12.024	1.773	0.2000
4	1034.3	743.0	821.3	698.2	628.7	254.0	823.8	843.2	844.2	913.6	-195.1	-589.2	60.45	61.37	11.485	1.746	0.3000
5	1016.1	739.8	812.8	695.2	609.7	252.9	836.2	855.6	843.8	920.1	-226.5	-602.7	60.44	61.37	10.988	1.713	0.4000
6	999.2	730.3	802.5	686.2	595.2	249.7	848.6	868.0	841.6	923.7	-253.4	-618.3	60.21	60.68	10.530	1.684	0.5000
7	983.2	720.3	792.0	676.9	582.6	246.3	861.0	880.4	839.6	927.5	-278.4	-634.1	59.90	59.92	10.108	1.662	0.6000
8	969.3	702.7	776.0	660.4	580.8	240.3	873.4	892.8	829.4	928.4	-292.6	-652.5	58.99	58.26	9.717	1.648	0.7000
9	954.9	672.9	757.0	632.3	582.0	230.0	885.8	905.2	815.7	925.0	-303.8	-675.2	57.75	55.41	9.357	1.650	0.8000
10	940.2	628.3	730.7	590.4	591.6	214.8	898.2	917.6	792.5	917.9	-306.6	-702.8	55.78	51.16	9.033	1.682	0.9000
11	912.5	533.3	671.7	501.2	617.6	182.3	910.6	930.0	732.9	900.1	-293.0	-747.7	50.85	42.45	8.752	1.763	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	TO/TO INLET	PO/PO INLET	EFF-AD INLET %	EFF-P INLET %	T02/T01	P02/P01	EFF-AD ROTOR %	EFF-P ROTOR %
36.68	179.07	1.1670	1.5906	84.88	85.83	1.5906	0.9629	86.06	160.02

TABLE 32. — INLET GUIDE VANE — NOMINAL TAKEOFF OD STREAM

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	V0'-1 M/SEC	V0'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	P0/P0 INLET
1	162.9	167.8	162.9	167.5	0.0	-9.6	220.9	230.3	274.4	292.6	-220.9	-239.9	177.43	180.11	0.0108	0.1671	0.9941
2	165.0	173.0	165.0	172.9	0.0	-6.3	246.0	254.5	296.2	312.9	-246.0	-260.8	179.21	184.32	0.0172	0.1375	0.9940
3	167.1	177.8	167.1	177.8	0.0	-3.1	271.2	278.7	318.5	333.2	-271.2	-281.8	180.88	188.10	0.0207	0.1108	0.9938
4	168.9	182.1	168.9	182.1	0.0	0.3	296.3	302.9	341.1	353.2	-296.3	-302.6	182.38	191.29	0.0209	0.0879	0.9938
5	170.5	185.5	170.5	185.5	0.0	3.9	321.5	327.1	363.9	372.7	-321.5	-323.2	183.62	193.72	0.0190	0.0676	0.9938
6	171.7	188.1	171.7	188.0	0.0	7.7	346.6	351.4	386.8	391.7	-346.6	-343.7	184.59	195.43	0.0161	0.0499	0.9938
7	172.7	189.9	172.7	189.5	0.0	11.5	371.8	375.6	409.9	410.4	-371.8	-364.0	185.32	196.35	0.0127	0.0348	0.9933
8	173.3	190.8	173.3	190.2	0.0	15.4	396.9	399.8	433.1	428.9	-396.9	-384.4	185.83	196.55	0.0092	0.0224	0.9923
9	173.7	190.9	173.7	189.9	0.0	19.1	422.1	424.0	456.4	447.2	-422.1	-404.9	186.14	195.83	0.0058	0.0128	0.9902
10	173.9	190.1	173.9	188.7	0.0	22.7	447.3	448.2	479.9	465.4	-447.3	-425.5	186.27	194.17	0.0027	0.0055	0.9868
11	173.9	188.3	173.9	186.5	0.0	26.2	472.4	472.4	503.4	483.6	-472.4	-446.2	186.26	191.51	-0.0000	-0.0000	0.9819

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	%EFF-A TOTAL	%EFF-P TOTAL
1	0.0	-3.3	53.53	55.37	0.4899	0.5055	0.8254	0.8813	23.749	24.765	9.350	9.750	-0.0115	0.0388	0.0071	0.9941	0.0	0.0
2	0.0	-2.1	56.10	56.67	0.4967	0.5219	0.8916	0.9441	26.454	27.368	10.415	10.775	-0.0358	0.0390	0.0070	0.9940	0.0	0.0
3	0.0	-1.0	58.34	57.88	0.5032	0.5374	0.9592	1.0069	29.159	29.972	11.480	11.800	-0.0585	0.0388	0.0069	0.9938	0.0	0.0
4	0.0	0.1	60.30	59.04	0.5091	0.5510	1.0278	1.0687	31.864	32.575	12.545	12.825	-0.0764	0.0382	0.0066	0.9938	0.0	0.0
5	0.0	1.2	62.05	60.19	0.5140	0.5620	1.0971	1.1290	34.569	35.179	13.610	13.850	-0.0804	0.0376	0.0064	0.9938	0.0	0.0
6	0.0	2.3	63.64	61.35	0.5179	0.5704	1.1667	1.1877	37.274	37.782	14.675	14.875	-0.0798	0.0374	0.0062	0.9938	0.0	0.0
7	0.0	3.5	65.09	62.51	0.5209	0.5760	1.2367	1.2452	39.980	40.386	15.740	15.900	-0.0759	0.0397	0.0064	0.9933	0.0	0.0
8	0.0	4.6	66.41	63.68	0.5230	0.5792	1.3069	1.3018	42.685	42.990	16.805	16.925	-0.0692	0.0452	0.0071	0.9923	0.0	0.0
9	0.0	5.7	67.63	64.87	0.5242	0.5794	1.3775	1.3573	45.390	45.593	17.870	17.950	-0.0589	0.0573	0.0088	0.9902	0.0	0.0
10	0.0	6.9	68.76	66.08	0.5248	0.5767	1.4482	1.4122	48.095	48.196	18.935	18.975	-0.0451	0.0772	0.0114	0.9868	0.0	0.0
11	0.0	8.0	69.79	67.32	0.5247	0.5710	1.5192	1.4665	50.800	50.800	20.000	20.000	-0.0272	0.1058	0.0151	0.9819	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	V0'-1 FT/SEC	V0'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	534.3	550.6	534.3	549.7	0.0	-31.3	724.6	755.6	900.3	959.9	-724.6	-787.0	36.34	36.89	0.621	9.574	0.0000
2	541.4	567.6	541.4	567.2	0.0	-20.7	807.2	835.1	971.9	1026.6	-807.2	-855.7	36.70	37.75	0.986	7.880	0.1000
3	548.2	583.5	548.2	583.4	0.0	-10.1	889.7	914.5	1045.0	1093.3	-889.7	-924.6	37.05	38.52	1.186	6.350	0.2000
4	554.3	597.4	554.3	597.4	0.0	1.0	972.2	993.9	1119.1	1158.8	-972.2	-992.9	37.35	39.18	1.197	5.035	0.3000
5	559.4	608.7	559.4	608.5	0.0	12.9	1054.8	1073.4	1193.9	1222.7	-1054.8	-1060.5	37.61	39.68	1.088	3.875	0.4000
6	563.5	617.2	563.5	616.7	0.0	25.3	1137.3	1152.8	1269.2	1285.2	-1137.3	-1127.6	37.81	40.03	0.921	2.858	0.5000
7	566.5	622.9	566.5	621.8	0.0	37.8	1219.8	1232.2	1345.0	1346.6	-1219.8	-1194.4	37.96	40.21	0.729	1.993	0.6000
8	568.6	626.1	568.6	624.1	0.0	50.4	1302.4	1311.7	1421.1	1407.2	-1302.4	-1261.3	38.06	40.26	0.528	1.285	0.7000
9	569.9	626.3	569.9	623.2	0.0	62.7	1384.9	1391.1	1497.6	1467.3	-1384.9	-1328.4	38.12	40.11	0.333	0.732	0.8000
10	570.5	623.6	570.5	619.1	0.0	74.6	1467.5	1470.6	1574.5	1527.1	-1467.5	-1395.9	38.15	39.77	0.154	0.314	0.9000
11	570.4	617.9	570.4	611.8	0.0	86.0	1550.0	1550.0	1651.6	1586.7	-1550.0	-1464.0	38.15	39.22	-0.000	-0.000	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T02/T01	P02/P01	EFF-AD ROTOR %	EFF-P ROTOR %
36.96	180.48	1.0000	0.9915	0.0	0.0	0.0	0.9915	0.0	0.0

TABLE 33. — ROTOR ONE — NOMINAL TAKEOFF OD STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-I M/SEC	V-2 M/SEC	VM-I M/SEC	VM-2 M/SEC	VO-I M/SEC	VO-2 M/SEC	RHOVM-I KG/M2 SEC	RHOVM-2 KG/M2 SEC	PO/PO INLET	TO/TO INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-I RADIAN	EPSI-2 RADIAN
1	191.2	265.2	191.0	193.7	-9.0	181.1	197.61	258.60	1.6850	1.1777	90.44	91.11	0.2146	0.2360
2	194.3	245.5	194.2	188.2	-5.8	157.5	199.79	255.77	1.6326	1.1637	91.82	92.37	0.1712	0.1810
3	196.8	229.9	196.8	180.8	-2.5	142.1	201.47	248.42	1.5921	1.1544	92.05	92.55	0.1320	0.1366
4	198.4	217.4	198.4	172.3	1.0	132.5	202.52	238.44	1.5607	1.1490	91.03	91.57	0.0980	0.1006
5	198.9	207.2	198.9	164.4	4.6	126.2	202.84	228.41	1.5367	1.1457	89.67	90.27	0.0695	0.0717
6	198.6	199.1	198.5	157.3	8.4	122.0	202.49	219.32	1.5191	1.1438	88.25	88.92	0.0469	0.0491
7	197.6	192.5	197.3	151.0	12.1	119.4	201.53	211.01	1.5064	1.1432	86.76	87.51	0.0297	0.0322
8	196.2	188.2	195.6	146.1	15.8	118.6	200.10	204.63	1.5012	1.1446	85.11	85.94	0.0178	0.0199
9	194.5	187.3	193.5	143.5	19.5	120.4	198.18	201.12	1.5062	1.1496	83.01	83.97	0.0098	0.0112
10	192.5	191.0	191.1	143.6	22.9	126.0	195.78	200.99	1.5253	1.1605	79.88	81.04	0.0040	0.0047
11	190.2	205.2	188.4	139.8	26.2	150.2	192.86	191.81	1.5740	1.2023	68.37	70.31	-0.0000	-0.0000

SL	B-1 DEGREE	B-2 DEGREE	M-1	M-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D-FAC	OMEGA-B TOTAL	LOSS-P TOTAL	PO2/ PO1	PO/PO STAGE	TO/TO STAGE	%EFF-A TOT-STG	%EFF-P TOT-STG
1	-2.7	43.1	0.5805	0.7585	26.314	29.240	10.360	11.512	0.4697	0.1056	0.0186	1.6950	0.0	0.0	0.0	0.0
2	-1.7	39.7	0.5905	0.7009	28.763	31.397	11.324	12.361	0.4392	0.0734	0.0143	1.6426	0.0	0.0	0.0	0.0
3	-0.7	37.8	0.5985	0.6554	31.212	33.553	12.288	13.210	0.4155	0.0607	0.0126	1.6020	0.0	0.0	0.0	0.0
4	0.3	37.2	0.6037	0.6185	33.660	35.707	13.252	14.058	0.3974	0.0624	0.0137	1.5704	0.0	0.0	0.0	0.0
5	1.3	37.2	0.6056	0.5885	36.109	37.864	14.216	14.907	0.3798	0.0676	0.0154	1.5463	0.0	0.0	0.0	0.0
6	2.4	37.5	0.6045	0.5643	38.557	40.020	15.180	15.756	0.3619	0.0731	0.0172	1.5291	0.0	0.0	0.0	0.0
7	3.5	38.1	0.6013	0.5445	41.006	42.177	16.144	16.605	0.3445	0.0788	0.0191	1.5173	0.0	0.0	0.0	0.0
8	4.6	38.9	0.5966	0.5315	43.454	44.333	17.108	17.454	0.3294	0.0857	0.0213	1.5141	0.0	0.0	0.0	0.0
9	5.7	39.9	0.5910	0.5276	45.903	46.487	18.072	18.302	0.3185	0.0963	0.0245	1.5225	0.0	0.0	0.0	0.0
10	6.8	41.3	0.5846	0.5360	48.351	48.644	19.036	19.151	0.3158	0.1167	0.0301	1.5467	0.0	0.0	0.0	0.0
11	7.9	47.0	0.5772	0.5676	50.800	50.800	20.000	20.000	0.3652	0.2223	0.0536	1.6030	0.0	0.0	0.0	0.0

SL	V-I FT/SEC	V-2 FT/SEC	VM-I FT/SEC	VM-2 FT/SEC	VO-I FT/SEC	VO-2 FT/SEC	RHOVM-I LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	PCT TE SPAN	TO/TO INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-I DEGREE	EPSI-2 DEGREE
1	627.4	870.2	626.7	635.7	-29.5	594.3	40.47	52.96	0.0000	1.1777	90.44	91.11	12.295	13.519
2	637.6	805.3	637.3	617.6	-19.1	516.8	40.92	52.38	0.1000	1.1637	91.82	92.37	9.809	10.370
3	645.6	754.3	645.6	593.1	-8.3	466.1	41.26	50.88	0.2000	1.1544	92.05	92.55	7.563	7.827
4	650.8	713.3	650.8	565.5	3.2	434.8	41.48	48.83	0.3000	1.1490	91.03	91.57	5.613	5.763
5	652.7	680.0	652.5	539.3	15.2	414.1	41.54	46.78	0.4000	1.1457	89.67	90.27	3.985	4.105
6	651.7	653.2	651.1	516.2	27.5	400.3	41.47	44.92	0.5000	1.1438	88.25	88.92	2.685	2.814
7	648.4	631.5	647.2	495.4	39.8	391.6	41.28	43.22	0.6000	1.1432	86.76	87.51	1.704	1.844
8	643.7	617.5	641.6	479.5	52.0	389.2	40.98	41.91	0.7000	1.1446	85.11	85.94	1.017	1.140
9	638.0	614.6	634.8	470.8	63.8	395.1	40.59	41.19	0.8000	1.1496	83.01	83.97	0.563	0.639
10	631.6	626.8	627.1	471.0	75.2	413.6	40.10	41.16	0.9000	1.1605	79.88	81.04	0.230	0.271
11	624.1	673.3	618.2	458.8	86.0	492.8	39.50	39.28	1.0000	1.2023	68.37	70.31	-0.000	-0.000

NCORR INLET RPM	WCORR INLET LBM/SEC	WCORR INLET KG/SEC	TO/TO INLET	PO/PO INLET	EFF-AD INLET %	EFF-P INLET %	TO/TO STAGE	PO2/PO1	PO/PO STAGE	EFF-AD STAGE %	EFF-P STAGE %
17761.70	63.17	28.65	1.1541	1.5476	86.23	87.05	0.0	1.5609	1.5476	0.0	0.0

TABLE 34. — STATOR ONE — NOMINAL TAKEOFF OD STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	V0'-1 M/SEC	V0'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	P0/P0 INLET
1	280.7	194.8	220.2	194.8	174.1	0.0	283.0	291.7	245.7	350.8	-108.9	-291.7	283.90	272.15	0.1896	0.0455	1.5503
2	257.3	196.3	207.7	196.3	151.8	0.0	301.9	309.8	256.3	366.8	-150.1	-309.8	275.21	280.54	0.1540	0.0483	1.5729
3	239.4	189.3	195.8	189.3	137.9	0.0	320.9	327.9	268.0	378.6	-183.0	-327.9	263.88	273.64	0.1254	0.0468	1.5635
4	225.3	180.0	184.3	180.0	129.5	0.0	339.8	345.9	279.6	390.0	-210.3	-345.9	251.13	261.65	0.1022	0.0437	1.5444
5	213.9	170.7	174.2	170.7	124.0	0.0	358.8	364.0	292.3	402.0	-234.7	-364.0	239.17	248.59	0.0832	0.0402	1.5239
6	204.8	163.1	165.7	163.1	120.5	0.0	377.7	382.1	306.0	415.4	-257.2	-382.1	228.64	237.71	0.0674	0.0364	1.5079
7	197.6	157.2	158.3	157.2	118.3	0.0	396.6	400.1	320.2	429.9	-278.4	-400.1	219.38	229.22	0.0536	0.0321	1.4963
8	193.2	154.0	153.0	154.0	118.0	0.0	415.6	418.2	334.6	445.6	-297.6	-418.2	212.58	224.23	0.0410	0.0269	1.4908
9	192.3	153.4	150.2	153.4	120.1	0.0	434.5	436.3	348.5	462.5	-314.4	-436.3	208.99	222.77	0.0287	0.0204	1.4910
10	196.1	156.9	150.3	156.9	125.9	0.0	453.5	454.3	360.4	480.7	-327.5	-454.3	208.88	226.41	0.0160	0.0125	1.5000
11	210.2	169.6	147.0	169.6	150.2	0.0	472.4	472.4	354.2	502.0	-322.2	-472.4	200.10	237.39	-0.0000	-0.0000	1.5265

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	%EFF-A TOTAL	%EFF-P TOTAL
1	38.7	0.0	26.62	56.17	0.8083	0.5429	0.7075	0.9777	30.429	31.369	11.980	12.350	0.4597	0.2289	0.0322	0.9200	76.15	92.14
2	36.4	0.0	36.07	57.56	0.7384	0.5510	0.7355	1.0293	32.466	33.312	12.782	13.115	0.3944	0.1158	0.0167	0.9640	85.79	93.54
3	35.3	0.0	43.21	59.95	0.6852	0.5323	0.7669	1.0647	34.503	35.255	13.584	13.880	0.3730	0.0625	0.0089	0.9828	89.72	93.79
4	35.2	0.0	48.85	62.47	0.6428	0.5062	0.7980	1.0965	36.540	37.198	14.386	14.645	0.3733	0.0392	0.0054	0.9904	90.22	92.80
5	35.5	0.0	53.46	64.85	0.6087	0.4795	0.8320	1.1292	38.578	39.141	15.188	15.410	0.3853	0.0348	0.0047	0.9923	89.27	91.53
6	36.1	0.0	57.24	66.87	0.5817	0.4576	0.8689	1.1654	40.615	41.084	15.990	16.175	0.3994	0.0346	0.0045	0.9929	88.08	90.28
7	36.8	0.0	60.39	68.54	0.5601	0.4406	0.9075	1.2047	42.652	43.028	16.792	16.940	0.4131	0.0345	0.0044	0.9934	86.88	89.04
8	37.6	0.0	62.80	69.79	0.5463	0.4308	0.9463	1.2469	44.689	44.971	17.594	17.705	0.4253	0.0380	0.0048	0.9930	85.47	87.77
9	38.6	0.0	64.47	70.63	0.5425	0.4282	0.9829	1.2910	46.726	46.914	18.396	18.470	0.4387	0.0547	0.0069	0.9901	83.24	86.23
10	40.0	0.0	65.35	70.94	0.5511	0.4364	1.0126	1.3367	48.763	48.857	19.198	19.235	0.4524	0.0857	0.0111	0.9840	79.56	83.82
11	45.6	0.0	65.47	70.25	0.5823	0.4646	0.9811	1.3745	50.800	50.800	20.000	20.000	0.4883	0.1468	0.0205	0.9699	66.40	73.14

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	V0'-1 FT/SEC	V0'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	921.0	639.1	722.6	639.1	571.1	0.0	928.4	957.1	806.1	1150.9	-357.3	-957.1	58.15	55.74	10.864	2.608	0.0000
2	844.2	644.1	681.5	644.1	498.2	0.0	990.6	1016.4	840.8	1203.3	-492.4	-1016.4	56.37	57.46	8.825	2.767	0.1000
3	785.6	621.0	642.3	621.0	452.3	0.0	1052.8	1075.7	879.3	1242.1	-600.5	-1075.7	54.05	56.04	7.187	2.682	0.2000
4	739.1	590.7	604.8	590.7	424.9	0.0	1114.9	1135.0	917.5	1279.5	-690.0	-1135.0	51.43	53.59	5.858	2.506	0.3000
5	701.7	560.1	571.7	560.1	406.9	0.0	1177.1	1194.3	959.1	1319.1	-770.1	-1194.3	48.98	50.91	4.767	2.303	0.4000
6	672.1	535.1	543.5	535.1	395.2	0.0	1239.2	1253.6	1003.9	1363.0	-844.0	-1253.6	46.83	48.69	3.860	2.087	0.5000
7	648.4	515.9	519.4	515.9	388.1	0.0	1301.4	1312.8	1050.7	1410.6	-913.3	-1312.8	44.93	46.95	3.074	1.841	0.6000
8	633.9	505.1	502.0	505.1	387.0	0.0	1363.5	1372.1	1098.0	1462.2	-976.5	-1372.1	43.54	45.93	2.350	1.541	0.7000
9	631.0	503.3	492.9	503.3	394.0	0.0	1425.7	1431.4	1143.4	1517.3	-1031.7	-1431.4	42.80	45.63	1.644	1.171	0.8000
10	643.5	514.9	493.3	514.9	413.2	0.0	1487.8	1490.7	1182.4	1577.1	-1074.6	-1490.7	42.78	46.37	0.918	0.717	0.9000
11	689.6	556.6	482.4	556.6	492.8	0.0	1550.0	1550.0	1162.0	1646.9	-1057.2	-1550.0	40.98	48.62	-0.000	-0.000	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T02/T01	P02/P01	EFF-AD ROTOR %	EFF-P ROTOR %
31.47	153.68	1.1541	1.5215	82.67	83.66	1.5215	0.9831	84.45	153.45

TABLE 35. — INLET GUIDE VANE — MAXIMUM CONTROL TAKEOFF ID STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	V0'-1 M/SEC	V0'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	P0/P0 INLET
1	175.4	159.0	175.4	151.4	0.0	-48.5	127.6	129.9	216.8	234.0	-127.6	-178.4	187.42	161.20	-0.0216	0.1674	0.9716
2	177.2	166.5	177.2	158.6	0.0	-50.8	136.2	139.2	223.5	247.5	-136.2	-190.0	188.85	167.88	-0.0129	0.1775	0.9770
3	179.1	173.7	179.1	165.5	0.0	-52.9	144.8	148.6	230.3	260.7	-144.8	-201.5	190.23	174.25	-0.0059	0.1842	0.9828
4	180.8	180.1	180.8	171.6	0.0	-54.8	153.4	157.9	237.1	273.3	-153.4	-212.7	191.52	179.71	-0.0004	0.1876	0.9877
5	182.4	185.0	182.4	176.2	0.0	-56.3	162.0	167.2	244.0	284.6	-162.0	-223.5	192.71	183.55	0.0036	0.1890	0.9901
6	183.9	188.9	183.9	180.0	0.0	-57.4	170.7	176.6	250.9	295.2	-170.7	-234.0	193.79	186.31	0.0066	0.1892	0.9909
7	185.2	192.2	185.2	183.1	0.0	-58.5	179.3	185.9	257.8	305.4	-179.3	-244.3	194.78	188.55	0.0087	0.1888	0.9912
8	186.5	195.2	186.5	185.9	0.0	-59.3	187.9	195.2	264.7	315.2	-187.9	-254.6	195.66	190.43	0.0101	0.1881	0.9913
9	187.6	197.7	187.6	188.3	0.0	-60.1	196.5	204.6	271.7	324.8	-196.5	-264.7	196.44	192.01	0.0109	0.1872	0.9913
10	188.5	199.8	188.5	190.4	0.0	-60.8	205.1	213.9	278.6	334.2	-205.1	-274.7	197.12	193.31	0.0112	0.1861	0.9911
11	189.4	201.6	189.4	192.1	0.0	-61.3	213.8	223.2	285.6	343.3	-213.8	-284.6	197.70	194.36	0.0111	0.1848	0.9910

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	%EFF-A TOTAL	%EFF-P TOTAL
1	0.0	-18.0	36.03	50.06	0.5295	0.4778	0.6547	0.7032	13.716	13.970	5.400	5.500	0.1672	0.1635	0.0280	0.9716	0.0	0.0
2	0.0	-18.0	37.52	50.58	0.5355	0.5014	0.6753	0.7453	14.643	14.973	5.765	5.895	0.1387	0.1299	0.0225	0.9770	0.0	0.0
3	0.0	-18.0	38.94	51.06	0.5413	0.5243	0.6961	0.7868	15.570	15.977	6.130	6.290	0.1119	0.0955	0.0166	0.9828	0.0	0.0
4	0.0	-18.0	40.29	51.58	0.5468	0.5446	0.7172	0.8263	16.497	16.980	6.495	6.685	0.0896	0.0669	0.0117	0.9877	0.0	0.0
5	0.0	-18.0	41.58	52.21	0.5520	0.5604	0.7384	0.8621	17.424	17.983	6.860	7.080	0.0746	0.0530	0.0093	0.9901	0.0	0.0
6	0.0	-18.0	42.82	52.90	0.5568	0.5729	0.7596	0.8953	18.351	18.987	7.225	7.475	0.0643	0.0481	0.0085	0.9909	0.0	0.0
7	0.0	-18.0	44.01	53.59	0.5611	0.5837	0.7809	0.9272	19.278	19.990	7.590	7.870	0.0563	0.0459	0.0081	0.9912	0.0	0.0
8	0.0	-18.0	45.16	54.29	0.5651	0.5932	0.8023	0.9582	20.205	20.993	7.955	8.265	0.0497	0.0448	0.0079	0.9913	0.0	0.0
9	0.0	-18.0	46.27	54.98	0.5686	0.6014	0.8236	0.9883	21.133	21.996	8.320	8.660	0.0444	0.0444	0.0078	0.9913	0.0	0.0
10	0.0	-18.0	47.35	55.68	0.5717	0.6085	0.8450	1.0176	22.060	23.000	8.685	9.055	0.0402	0.0445	0.0078	0.9911	0.0	0.0
11	0.0	-18.0	48.39	56.37	0.5744	0.6143	0.8663	1.0461	22.987	24.003	9.050	9.450	0.0387	0.0450	0.0079	0.9910	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	V0'-1 FT/SEC	V0'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	575.3	521.8	575.3	496.9	0.0	-159.2	418.5	426.2	711.5	767.9	-418.5	-585.4	38.38	33.02	-1.240	9.590	0.0000
2	581.5	546.4	581.5	520.4	0.0	-166.6	446.8	456.9	733.3	812.1	-446.8	-623.5	38.68	34.38	-0.741	10.167	0.1000
3	587.5	570.0	587.5	542.9	0.0	-173.6	475.1	487.5	755.5	855.4	-475.1	-661.1	38.96	35.69	-0.336	10.554	0.2000
4	593.2	590.9	593.2	562.9	0.0	-179.8	503.4	518.1	778.0	896.6	-503.4	-697.8	39.22	36.81	-0.025	10.751	0.3000
5	598.4	607.0	598.4	578.2	0.0	-184.6	531.6	548.7	800.5	933.8	-531.6	-733.3	39.47	37.59	0.205	10.827	0.4000
6	603.3	619.8	603.3	590.4	0.0	-188.4	559.9	579.3	823.1	968.5	-559.9	-767.8	39.69	38.16	0.376	10.840	0.5000
7	607.8	630.7	607.8	600.9	0.0	-191.8	588.2	609.9	845.8	1001.9	-588.2	-801.7	39.89	38.62	0.499	10.820	0.6000
8	611.8	640.3	611.8	610.0	0.0	-194.7	616.5	640.5	868.6	1034.3	-616.5	-835.3	40.07	39.00	0.580	10.780	0.7000
9	615.4	648.6	615.4	617.9	0.0	-197.3	644.8	671.1	891.4	1065.8	-644.8	-868.4	40.23	39.33	0.627	10.726	0.8000
10	618.6	655.6	618.6	624.6	0.0	-199.4	673.1	701.8	914.2	1096.5	-673.1	-901.2	40.37	39.59	0.644	10.662	0.9000
11	621.3	661.5	621.3	630.2	0.0	-201.3	701.4	732.4	937.0	1126.4	-701.4	-933.6	40.49	39.81	0.638	10.588	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T02/T01	P02/P01	EFF-AD ROTOR %	EFF-P ROTOR %
38.90	189.94	1.0000	0.9884	0.0	0.0	0.0	0.9884	0.0	0.0

TABLE 36. — ROTOR ONE — MAXIMUM CONTROL TAKEOFF ID STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	P0/P0 INLET	T0/T0 INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-1 RADIAN	EPSI-2 RADIAN
1	194.1	299.2	190.3	176.3	-38.1	241.7	191.42	221.00	1.7454	1.2130	80.95	82.37	0.4131	0.3300
2	197.9	300.6	193.5	199.1	-41.4	225.2	194.54	254.90	1.7849	1.2061	87.33	88.31	0.3922	0.3132
3	201.8	300.6	196.9	213.1	-44.4	212.0	197.75	277.26	1.8084	1.2016	91.46	92.14	0.3721	0.2976
4	205.0	299.1	199.5	221.4	-46.9	201.1	200.10	291.76	1.8212	1.1985	94.10	94.57	0.3528	0.2831
5	207.0	297.2	201.1	225.4	-49.0	193.8	201.33	299.54	1.8276	1.1979	94.98	95.39	0.3343	0.2693
6	208.5	295.0	202.2	227.1	-50.8	188.3	201.95	303.70	1.8297	1.1985	94.89	95.30	0.3165	0.2563
7	209.6	292.6	203.0	228.3	-52.3	183.1	202.31	307.05	1.8300	1.1990	94.64	95.08	0.2995	0.2438
8	210.5	290.3	203.5	226.8	-53.7	181.2	202.52	305.76	1.8274	1.2024	92.85	93.42	0.2830	0.2319
9	211.1	287.5	203.8	223.6	-54.9	180.7	202.59	301.49	1.8200	1.2067	90.23	91.01	0.2673	0.2206
10	211.4	284.0	203.9	217.3	-55.9	182.9	202.50	292.11	1.8071	1.2134	86.26	87.35	0.2523	0.2099
11	211.5	274.7	203.7	196.9	-56.8	191.5	202.27	261.25	1.7591	1.2259	77.46	79.16	0.2385	0.2000

SL	B-1 DEGREE	B-2 DEGREE	M-1	M-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D-FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	P0/P0 STAGE	T0/T0 STAGE	%EFF-A TOT-STG	%EFF-P TOT-STG
1	-11.1	52.5	0.5897	0.8547	17.780	24.638	7.000	9.700	0.5642	0.2653	0.0285	1.7965	0.0	0.0	0.0	0.0
2	-11.8	47.1	0.6022	0.8623	18.593	25.080	7.320	9.874	0.4956	0.1546	0.0191	1.8256	0.0	0.0	0.0	0.0
3	-12.5	43.6	0.6151	0.8640	19.406	25.522	7.640	10.048	0.4585	0.0939	0.0127	1.8374	0.0	0.0	0.0	0.0
4	-13.0	41.1	0.6253	0.8604	20.218	25.964	7.960	10.222	0.4392	0.0594	0.0086	1.8420	0.0	0.0	0.0	0.0
5	-13.5	39.7	0.6321	0.8544	21.031	26.406	8.280	10.396	0.4350	0.0479	0.0073	1.8452	0.0	0.0	0.0	0.0
6	-13.9	38.8	0.6369	0.8468	21.844	26.848	8.600	10.570	0.4376	0.0488	0.0078	1.8463	0.0	0.0	0.0	0.0
7	-14.3	38.0	0.6405	0.8388	22.657	27.290	8.920	10.744	0.4399	0.0508	0.0084	1.8462	0.0	0.0	0.0	0.0
8	-14.7	38.0	0.6434	0.8300	23.470	27.732	9.240	10.918	0.4535	0.0731	0.0124	1.8434	0.0	0.0	0.0	0.0
9	-15.0	38.5	0.6455	0.8191	24.282	28.174	9.560	11.092	0.4721	0.1049	0.0181	1.8361	0.0	0.0	0.0	0.0
10	-15.3	39.8	0.6466	0.8054	25.095	28.616	9.880	11.266	0.5018	0.1535	0.0267	1.8233	0.0	0.0	0.0	0.0
11	-15.6	44.0	0.6468	0.7713	25.908	29.058	10.200	11.440	0.5762	0.2639	0.0439	1.7751	0.0	0.0	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	PCT TE SPAN	T0/T0 INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-1 DEGREE	EPSI-2 DEGREE
1	636.7	981.7	624.3	578.6	-125.1	793.0	39.20	45.26	0.0000	1.2130	80.95	82.37	23.667	18.906
2	649.4	986.3	635.0	653.2	-135.8	739.0	39.84	52.21	0.1000	1.2061	87.33	88.31	22.472	17.942
3	662.2	986.3	646.0	699.1	-145.6	695.7	40.50	56.78	0.2000	1.2016	91.46	92.14	21.319	17.050
4	672.5	981.4	654.6	726.5	-154.0	659.8	40.98	59.75	0.3000	1.1985	94.10	94.57	20.213	16.218
5	679.3	975.3	660.0	739.5	-160.8	635.8	41.23	61.35	0.4000	1.1979	94.98	95.39	19.153	15.432
6	684.0	967.9	663.4	745.0	-166.6	617.8	41.36	62.20	0.5000	1.1985	94.89	95.30	18.137	14.684
7	687.6	960.1	665.9	749.1	-171.6	600.6	41.44	62.89	0.6000	1.1990	94.64	95.08	17.159	13.970
8	690.5	952.6	667.7	744.3	-176.1	594.6	41.48	62.62	0.7000	1.2024	92.85	93.42	16.217	13.288
9	692.5	943.2	668.7	733.6	-180.0	592.9	41.49	61.75	0.8000	1.2067	90.23	91.01	15.314	12.640
10	693.6	931.8	668.9	712.8	-183.5	600.1	41.47	59.83	0.9000	1.2134	86.26	87.35	14.453	12.028
11	693.9	901.2	668.4	646.0	-186.5	628.3	41.43	53.51	1.0000	1.2259	77.46	79.16	13.663	11.461

NCORR INLET RPM	WCORR INLET LBM/SEC	WCORR INLET KG/SEC	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T0/T0 STAGE	P02/P01	P0/P0 STAGE	EFF-AD STAGE %	EFF-P STAGE %
17761.70	11.20	5.08	1.2042	1.8129	90.70	91.44	0.0	1.8342	1.8129	0.0	0.0

TABLE 37. — STATOR ONE — MAXIMUM CONTROL TAKEOFF ID STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	V0'-1 M/SEC	V0'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	P0/P0 INLET
1	309.6	161.8	206.1	152.0	231.0	55.3	239.8	245.7	206.3	243.6	-8.8	-190.3	251.68	218.41	0.2316	0.0308	1.5646
2	310.9	195.3	224.5	183.6	215.1	66.8	243.5	249.4	226.3	258.9	-28.5	-182.6	280.58	270.68	0.2189	0.0316	1.6738
3	310.1	212.7	234.6	199.9	202.8	72.7	247.3	253.2	238.7	269.3	-44.5	-180.5	298.33	299.68	0.2079	0.0316	1.7404
4	307.9	221.5	240.1	208.1	192.7	75.7	251.1	257.0	247.1	276.0	-58.4	-181.3	309.67	315.48	0.1983	0.0311	1.7815
5	305.3	224.7	241.7	211.2	186.5	76.8	254.9	260.8	251.2	280.1	-68.4	-183.9	314.91	321.61	0.1897	0.0304	1.7996
6	302.3	224.7	241.7	211.1	181.5	76.8	258.6	264.6	253.7	282.5	-77.1	-187.7	317.52	322.08	0.1819	0.0299	1.8032
7	299.2	223.9	241.3	210.4	176.9	76.5	262.4	268.3	256.0	284.7	-85.6	-191.8	319.38	321.39	0.1748	0.0294	1.8037
8	296.1	220.2	238.3	206.9	175.7	75.3	266.2	272.1	254.9	285.6	-90.5	-196.8	316.71	314.80	0.1683	0.0291	1.7900
9	292.4	211.9	233.9	199.2	175.5	72.5	270.0	275.9	252.3	284.7	-94.5	-203.4	311.64	300.79	0.1624	0.0290	1.7580
10	288.2	199.0	226.7	187.0	177.9	68.0	273.8	279.7	246.1	282.4	-95.8	-211.6	301.79	278.99	0.1572	0.0295	1.7108
11	278.4	168.2	206.7	158.1	186.5	57.5	277.5	283.5	225.9	275.8	-91.1	-225.9	272.05	229.94	0.1528	0.0308	1.6118

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	%EFF-A TOTAL	%EFF-P TOTAL
1	49.0	20.0	2.50	51.34	0.8889	0.4401	0.5923	0.6628	25.781	26.416	10.150	10.400	0.5955	0.2580	0.0342	0.8964	68.44	86.64
2	44.4	20.0	7.39	44.80	0.8964	0.5379	0.6525	0.7130	26.187	26.822	10.310	10.560	0.4728	0.1551	0.0237	0.9370	80.60	91.88
3	41.4	20.0	10.95	42.03	0.8956	0.5900	0.6896	0.7470	26.594	27.229	10.470	10.720	0.4039	0.0943	0.0154	0.9617	87.74	94.75
4	39.2	20.0	13.89	41.01	0.8896	0.6170	0.7139	0.7689	27.000	27.635	10.630	10.880	0.3628	0.0557	0.0093	0.9776	92.37	96.55
5	38.1	20.0	16.03	41.01	0.8811	0.6268	0.7249	0.7811	27.407	28.042	10.790	11.040	0.3424	0.0396	0.0067	0.9843	93.89	96.88
6	37.3	20.0	17.93	41.60	0.8708	0.6264	0.7309	0.7878	27.813	28.448	10.950	11.200	0.3332	0.0374	0.0064	0.9854	93.89	95.69
7	36.6	20.0	19.76	42.30	0.8602	0.6240	0.7362	0.7934	28.219	28.854	11.110	11.360	0.3264	0.0375	0.0065	0.9857	93.62	96.41
8	36.7	20.0	21.02	43.52	0.8486	0.6118	0.7306	0.7934	28.626	29.261	11.270	11.520	0.3334	0.0537	0.0092	0.9799	90.48	94.37
9	37.2	20.0	22.23	45.56	0.8349	0.5861	0.7204	0.7873	29.032	29.667	11.430	11.680	0.3564	0.0911	0.0153	0.9667	85.69	91.92
10	38.4	20.0	23.13	48.48	0.8187	0.5465	0.6992	0.7756	29.439	30.074	11.590	11.840	0.3989	0.1458	0.0235	0.9485	78.68	88.01
11	42.3	20.0	23.98	54.97	0.7829	0.4559	0.6353	0.7473	29.845	30.480	11.750	12.000	0.5071	0.2516	0.0356	0.9162	65.95	80.43

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	V0'-1 FT/SEC	V0'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	1015.7	530.8	676.2	498.8	757.9	181.5	786.6	806.0	676.8	799.3	-28.8	-624.5	51.55	44.73	13.272	1.763	0.0000
2	1019.9	640.9	736.5	602.3	705.6	219.2	799.0	818.4	742.4	849.5	-93.4	-599.2	57.47	55.44	12.539	1.813	0.1000
3	1017.3	697.9	769.6	655.8	665.4	238.6	811.4	830.8	783.3	883.6	-146.1	-592.2	61.10	61.38	11.912	1.810	0.2000
4	1010.2	726.7	787.8	682.9	632.4	248.4	823.8	843.2	810.7	905.6	-191.5	-594.8	63.42	64.61	11.363	1.781	0.3000
5	1001.7	737.3	793.1	692.9	611.9	252.1	836.2	855.6	824.2	918.9	-224.3	-603.5	64.50	65.87	10.870	1.744	0.4000
6	991.8	737.1	793.0	692.7	595.6	252.0	848.6	868.0	832.4	927.0	-253.0	-616.0	65.03	65.97	10.422	1.710	0.5000
7	981.6	734.6	791.7	690.4	580.3	251.2	861.0	880.4	840.0	934.1	-280.7	-629.2	65.41	65.82	10.015	1.683	0.6000
8	971.4	722.5	781.8	678.9	576.6	247.0	873.4	892.8	836.3	937.0	-296.9	-645.8	64.86	64.47	9.643	1.665	0.7000
9	959.3	695.4	767.4	653.5	575.7	237.7	885.8	905.2	827.7	934.1	-310.1	-667.5	63.83	61.60	9.306	1.663	0.8000
10	945.5	653.0	743.7	613.6	583.8	223.2	898.2	917.6	807.5	926.7	-314.5	-694.4	61.81	57.14	9.007	1.690	0.9000
11	913.3	552.0	678.2	518.7	611.7	188.7	910.6	930.0	741.1	904.8	-298.9	-741.3	55.72	47.09	8.752	1.763	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T02/T01	P02/P01	EFF-AD ROTOR %	EFF-P ROTOR %
36.09	176.20	1.2042	1.7510	84.97	86.10	1.7510	0.9658	86.89	177.15

TABLE 38. — INLET GUIDE VANE — *MAXIMUM CONTROL TAKEOFF OD STREAM*

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	V0'-1 M/SEC	V0'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	P0/P0 INLET
1	193.6	218.5	193.6	208.9	0.0	-64.2	220.9	230.3	293.7	361.0	-220.9	-294.5	200.63	204.37	0.0108	0.1671	0.9905
2	196.2	222.9	196.2	214.3	0.0	-61.4	246.0	254.5	314.7	381.7	-246.0	-315.9	202.35	207.64	0.0159	0.1417	0.9900
3	198.6	227.2	198.6	219.6	0.0	-58.5	271.2	278.7	336.1	402.4	-271.2	-337.2	203.97	210.74	0.0189	0.1181	0.9897
4	200.9	231.3	200.9	224.6	0.0	-55.3	296.3	302.9	358.0	422.9	-296.3	-358.3	205.44	213.63	0.0195	0.0971	0.9895
5	202.9	234.9	202.9	229.2	0.0	-51.8	321.5	327.1	380.1	442.9	-321.5	-379.0	206.69	216.26	0.0182	0.0780	0.9897
6	204.5	238.0	204.5	233.1	0.0	-48.0	346.6	351.4	402.5	462.4	-346.6	-399.3	207.70	218.52	0.0159	0.0606	0.9899
7	205.8	240.3	205.8	236.2	0.0	-43.8	371.8	375.6	424.9	481.3	-371.8	-419.4	208.48	220.23	0.0130	0.0448	0.9896
8	206.7	241.6	206.7	238.4	0.0	-39.4	396.9	399.8	447.5	499.7	-396.9	-439.2	209.05	221.18	0.0098	0.0309	0.9879
9	207.3	242.5	207.3	240.0	0.0	-34.8	422.1	424.0	470.3	517.8	-422.1	-458.8	209.42	221.77	0.0064	0.0189	0.9860
10	207.6	242.9	207.6	241.1	0.0	-30.1	447.3	448.2	493.1	535.6	-447.3	-478.3	209.59	222.08	0.0031	0.0087	0.9840
11	207.6	243.1	207.6	241.8	0.0	-25.4	472.4	472.4	516.0	553.4	-472.4	-497.8	209.57	222.11	-0.0000	-0.0000	0.9816

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	%EFF-A TOTAL	%EFF-P TOTAL
1	0.0	-17.3	48.69	54.96	0.5882	0.6702	0.8923	1.1073	23.749	24.765	9.350	9.750	-0.0221	0.0452	0.0084	0.9905	0.0	0.0
2	0.0	-16.1	51.38	56.07	0.5966	0.6850	0.9568	1.1730	26.454	27.368	10.415	10.775	-0.0337	0.0466	0.0085	0.9900	0.0	0.0
3	0.0	-15.0	53.75	57.08	0.6046	0.6996	1.0231	1.2388	29.159	29.972	11.480	11.800	-0.0455	0.0473	0.0085	0.9897	0.0	0.0
4	0.0	-13.9	55.84	58.02	0.6120	0.7134	1.0906	1.3041	31.864	32.575	12.545	12.825	-0.0575	0.0471	0.0084	0.9895	0.0	0.0
5	0.0	-12.8	57.73	58.90	0.6185	0.7257	1.1588	1.3680	34.569	35.179	13.610	13.850	-0.0695	0.0454	0.0080	0.9897	0.0	0.0
6	0.0	-11.6	59.46	59.77	0.6238	0.7361	1.2276	1.4302	37.274	37.782	14.675	14.875	-0.0812	0.0437	0.0076	0.9899	0.0	0.0
7	0.0	-10.5	61.03	60.63	0.6280	0.7439	1.2968	1.4904	39.980	40.386	15.740	15.900	-0.0917	0.0447	0.0077	0.9896	0.0	0.0
8	0.0	-9.4	62.49	61.51	0.6311	0.7486	1.3663	1.5482	42.685	42.990	16.805	16.925	-0.1002	0.0512	0.0087	0.9879	0.0	0.0
9	0.0	-8.3	63.84	62.39	0.6330	0.7516	1.4360	1.6048	45.390	45.593	17.870	17.950	-0.1085	0.0590	0.0099	0.9860	0.0	0.0
10	0.0	-7.1	65.10	63.25	0.6340	0.7532	1.5058	1.6607	48.095	48.196	18.935	18.975	-0.1169	0.0676	0.0111	0.9840	0.0	0.0
11	0.0	-6.0	66.28	64.10	0.6339	0.7538	1.5758	1.7159	50.800	50.800	20.000	20.000	-0.1259	0.0777	0.0126	0.9816	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	V0'-1 FT/SEC	V0'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	635.3	716.9	635.3	685.2	0.0	-210.6	724.6	755.6	963.7	1184.5	-724.6	-966.2	41.09	41.86	0.621	9.574	0.0000
2	643.7	731.4	643.7	703.1	0.0	-201.3	807.2	835.1	1032.4	1252.4	-807.2	-1036.4	41.44	42.53	0.911	8.117	0.1000
3	651.8	745.6	651.8	720.5	0.0	-191.9	889.7	914.5	1102.9	1320.3	-889.7	-1106.4	41.77	43.16	1.084	6.769	0.2000
4	659.2	759.0	659.2	736.9	0.0	-181.6	972.2	993.9	1174.7	1387.4	-972.2	-1175.5	42.08	43.75	1.117	5.564	0.3000
5	665.7	770.9	665.7	751.9	0.0	-170.1	1054.8	1073.4	1247.3	1453.1	-1054.8	-1243.5	42.33	44.29	1.045	4.469	0.4000
6	671.0	780.8	671.0	764.8	0.0	-157.4	1137.3	1152.8	1320.5	1517.1	-1137.3	-1310.2	42.54	44.75	0.912	3.470	0.5000
7	675.2	788.3	675.2	775.0	0.0	-143.8	1219.8	1232.2	1394.2	1579.3	-1219.8	-1376.0	42.70	45.10	0.744	2.567	0.6000
8	678.2	792.8	678.2	782.2	0.0	-129.2	1302.4	1311.7	1468.4	1639.5	-1302.4	-1440.9	42.82	45.30	0.559	1.770	0.7000
9	680.2	795.6	680.2	787.3	0.0	-114.1	1384.9	1391.1	1542.9	1698.7	-1384.9	-1505.3	42.89	45.42	0.369	1.082	0.8000
10	681.1	797.1	681.1	790.9	0.0	-98.9	1467.5	1470.6	1617.8	1757.5	-1467.5	-1569.4	42.93	45.48	0.180	0.497	0.9000
11	681.0	797.6	681.0	793.3	0.0	-83.4	1550.0	1550.0	1693.0	1815.8	-1550.0	-1633.4	42.92	45.49	-0.000	-0.000	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T02/T01	P02/P01	EFF-AD ROTOR %	EFF-P ROTOR %
41.62	203.20	1.0000	0.9878	0.0	0.0	0.0	0.9878	0.0	0.0

TABLE 39. — ROTOR ONE — MAXIMUM CONTROL TAKEOFF OD STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	V0-1 M/SEC	V0-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	P0/P0 INLET	T0/T0 INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-1 RADIAN	EPSI-2 RADIAN
1	249.4	262.5	241.9	188.8	-60.4	182.5	220.98	270.71	1.8493	1.2223	86.31	87.44	0.2146	0.2360
2	252.7	244.9	245.8	190.9	-58.6	153.4	222.56	278.67	1.8054	1.2094	87.78	88.75	0.1760	0.1841
3	255.5	230.1	249.2	187.3	-56.4	133.6	223.99	276.13	1.7635	1.2011	87.43	88.38	0.1401	0.1425
4	257.4	217.3	251.8	180.8	-53.7	120.6	225.21	267.54	1.7256	1.1966	85.73	86.78	0.1076	0.1080
5	253.2	206.6	253.2	173.9	-50.5	111.5	226.11	257.58	1.6936	1.1939	83.74	84.90	0.0795	0.0790
6	257.7	197.7	253.4	167.8	-46.8	104.6	226.60	248.52	1.6679	1.1918	82.04	83.28	0.0560	0.0553
7	256.1	190.2	252.5	162.1	-42.9	99.5	226.55	240.16	1.6472	1.1902	80.54	81.85	0.0372	0.0366
8	253.7	185.0	250.8	157.8	-38.7	96.7	225.97	233.47	1.6339	1.1905	79.02	80.41	0.0228	0.0223
9	251.3	183.2	249.0	155.5	-34.3	96.9	225.26	229.66	1.6313	1.1944	77.19	78.69	0.0123	0.0118
10	249.3	186.0	247.5	155.9	-29.9	101.4	224.56	229.36	1.6427	1.2042	74.58	76.28	0.0046	0.0045
11	247.9	197.9	246.6	151.2	-25.4	127.7	223.98	216.43	1.6788	1.2497	63.83	66.33	-0.0000	-0.0000

SL	B-1 DEGREE	B-2 DEGREE	M-1	M-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D-FAC	OMEGA-B TOTAL	LOSS-P TOTAL	P02/ P01	P0/P0 STAGE	T0/T0 STAGE	%EFF-A TOT-STG	%EFF-P TOT-STG
1	-14.0	44.0	0.7755	0.7347	26.314	29.240	10.360	11.512	0.6099	0.1374	0.0238	1.8670	0.0	0.0	0.0	0.0
2	-13.3	38.6	0.7871	0.6846	28.763	31.397	11.324	12.361	0.5549	0.1058	0.0209	1.8239	0.0	0.0	0.0	0.0
3	-12.6	35.2	0.7969	0.6421	31.212	33.553	12.288	13.210	0.5172	0.0974	0.0210	1.7821	0.0	0.0	0.0	0.0
4	-11.9	33.4	0.8038	0.6050	33.660	35.707	13.252	14.058	0.4901	0.1041	0.0239	1.7437	0.0	0.0	0.0	0.0
5	-11.2	32.4	0.8065	0.5737	36.109	37.864	14.216	14.907	0.4660	0.1140	0.0276	1.7110	0.0	0.0	0.0	0.0
6	-10.4	31.7	0.8047	0.5480	38.557	40.020	15.180	15.756	0.4419	0.1213	0.0307	1.6853	0.0	0.0	0.0	0.0
7	-9.6	31.4	0.7991	0.5266	41.006	42.177	16.144	16.605	0.4185	0.1264	0.0333	1.6661	0.0	0.0	0.0	0.0
8	-8.7	31.4	0.7908	0.5114	43.454	44.333	17.108	17.454	0.3977	0.1322	0.0361	1.6553	0.0	0.0	0.0	0.0
9	-7.8	31.9	0.7824	0.5053	45.903	46.487	18.072	18.302	0.3819	0.1425	0.0401	1.6555	0.0	0.0	0.0	0.0
10	-6.9	33.0	0.7752	0.5111	48.351	48.644	19.036	19.151	0.3739	0.1622	0.0466	1.6702	0.0	0.0	0.0	0.0
11	-5.9	40.2	0.7704	0.5352	50.800	50.800	20.000	20.000	0.4198	0.2691	0.0727	1.7103	0.0	0.0	0.0	0.0

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	V0-1 FT/SEC	V0-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	PCT TE SPAN	T0/T0 INLET	%EFF-A TOT-INLET	%EFF-P TOT-INLET	EPSI-1 DEGREE	EPSI-2 DEGREE
1	818.2	861.4	793.8	619.3	-198.2	598.7	45.26	55.44	0.0000	1.2223	86.31	87.44	12.295	13.519
2	829.1	803.4	806.4	626.2	-192.3	503.4	45.58	57.07	0.1000	1.2094	87.78	88.75	10.087	10.549
3	838.2	754.9	817.6	614.5	-185.0	438.4	45.88	56.55	0.2000	1.2011	87.43	88.38	8.027	8.165
4	844.7	713.1	826.1	593.2	-176.1	395.7	46.12	54.79	0.3000	1.1966	85.73	86.78	6.168	6.188
5	847.2	677.7	830.8	570.6	-165.6	365.7	46.31	52.75	0.4000	1.1939	83.74	84.90	4.554	4.528
6	845.5	648.6	831.5	550.4	-153.7	343.1	46.41	50.90	0.5000	1.1918	82.04	83.28	3.210	3.170
7	840.3	624.1	828.4	532.0	-140.8	326.3	46.40	49.19	0.6000	1.1902	80.54	81.85	2.130	2.098
8	832.5	607.1	822.8	517.6	-126.9	317.2	46.28	47.82	0.7000	1.1905	79.02	80.41	1.305	1.277
9	824.7	601.1	816.9	510.1	-112.6	318.0	46.13	47.04	0.8000	1.1944	77.19	78.69	0.704	0.675
10	817.9	610.2	812.0	511.5	-98.1	332.8	45.99	46.98	0.9000	1.2042	74.58	76.28	0.261	0.258
11	813.4	649.4	809.1	496.1	-83.4	419.1	45.87	44.33	1.0000	1.2497	63.83	66.33	-0.000	-0.000

NCORR INLET RPM	WCORR INLET LBM/SEC	WCORR INLET KG/SEC	T0/T0 INLET	P0/P0 INLET	EFF-AD INLET %	EFF-P INLET %	T0/T0 STAGE	P02/P01	P0/P0 STAGE	EFF-AD STAGE %	EFF-P STAGE %
17761.70	71.12	32.26	1.2003	1.6917	80.87	82.23	0.0	1.7126	1.6917	0.0	0.0

TABLE 40. — STATOR ONE — MAXIMUM CONTROL TAKEOFF OD STREAM

AIRFOIL AERODYNAMIC SUMMARY PRINT

RUN NO 0 SPEED CODE 0 POINT NO 0

SL	V-1 M/SEC	V-2 M/SEC	VM-1 M/SEC	VM-2 M/SEC	VO-1 M/SEC	VO-2 M/SEC	U-1 M/SEC	U-2 M/SEC	V'-1 M/SEC	V'-2 M/SEC	VO'-1 M/SEC	VO'-2 M/SEC	RHOVM-1 KG/M2 SEC	RHOVM-2 KG/M2 SEC	EPSI-1 RADIAN	EPSI-2 RADIAN	PO/PO INLET
1	201.6	213.1	220.3	213.1	175.3	0.0	283.0	291.7	245.2	361.3	-107.6	-291.7	303.31	311.02	0.1896	0.0455	1.7193
2	260.6	214.6	214.8	214.6	147.6	0.0	301.9	309.8	264.5	376.8	-154.4	-309.8	303.86	320.26	0.1492	0.0426	1.7461
3	243.2	207.5	206.0	207.5	129.3	0.0	320.9	327.9	281.3	388.0	-191.6	-327.9	296.01	312.83	0.1178	0.0382	1.7340
4	228.3	197.7	195.7	197.7	117.5	0.0	339.8	345.9	296.2	398.4	-222.3	-345.9	283.72	299.00	0.0928	0.0335	1.7082
5	215.7	187.5	186.0	187.5	109.2	0.0	358.8	364.0	311.2	409.5	-249.5	-364.0	270.98	283.70	0.0727	0.0291	1.6801
6	205.2	178.9	177.5	178.9	103.0	0.0	377.7	382.1	327.1	421.9	-274.7	-382.1	259.59	270.50	0.0564	0.0251	1.6568
7	196.4	171.5	169.9	171.5	98.4	0.0	396.6	400.1	343.3	435.4	-298.2	-400.1	249.19	259.26	0.0430	0.0212	1.6380
8	190.2	166.6	164.2	166.6	96.1	0.0	415.6	418.2	359.2	450.2	-319.5	-418.2	241.02	251.40	0.0316	0.0172	1.6258
9	187.7	164.3	160.9	164.3	96.7	0.0	434.5	436.3	374.2	466.2	-337.8	-436.3	236.12	247.06	0.0214	0.0128	1.6202
10	190.0	165.7	160.6	165.7	101.4	0.0	453.5	454.3	387.0	483.6	-352.1	-454.3	234.99	247.55	0.0117	0.0079	1.6238
11	201.6	174.7	155.9	174.7	127.7	0.0	472.4	472.4	378.3	503.7	-344.7	-472.4	222.00	252.15	-0.0000	-0.0000	1.6406

SL	B-1 DEGREE	B-2 DEGREE	B'-1 DEGREE	B'-2 DEGREE	M-1	M-2	M'-1	M'-2	DIA LE CM	DIA TE CM	DIA LE IN	DIA TE IN	D FAC	OMEGA-B TOTAL	LOSS-P TOTAL	PO2/ PO1	%EFF-A TOTAL	%EFF-P TOTAL
1	38.9	0.0	26.34	53.75	0.7944	0.5858	0.6918	0.9930	30.429	31.369	11.980	12.350	0.3973	0.2066	0.0309	0.9297	76.69	88.79
2	34.7	0.0	35.90	55.21	0.7333	0.5936	0.7443	1.0425	32.466	33.312	12.782	13.115	0.3252	0.1023	0.0157	0.9688	84.43	90.37
3	32.2	0.0	43.03	57.61	0.6821	0.5747	0.7890	1.0748	34.503	35.255	13.584	13.880	0.2945	0.0522	0.0080	0.9859	86.74	89.95
4	31.0	0.0	48.69	60.21	0.6381	0.5470	0.8278	1.1024	36.540	37.198	14.386	14.645	0.2854	0.0302	0.0045	0.9927	85.99	88.18
5	30.5	0.0	53.33	62.71	0.6009	0.5180	0.8670	1.1309	38.578	39.141	15.188	15.410	0.2879	0.0257	0.0037	0.9944	84.27	86.29
6	30.1	0.0	57.15	64.89	0.5703	0.4932	0.9089	1.1634	40.615	41.084	15.990	16.175	0.2931	0.0248	0.0035	0.9951	82.79	84.78
7	30.1	0.0	60.33	66.78	0.5446	0.4725	0.9519	1.1991	42.652	43.028	16.792	16.940	0.2999	0.0244	0.0034	0.9956	81.62	83.60
8	30.3	0.0	62.81	68.27	0.5264	0.4581	0.9942	1.2380	44.689	44.971	17.594	17.705	0.3078	0.0265	0.0036	0.9955	80.38	82.45
9	31.0	0.0	64.54	69.36	0.5182	0.4508	1.0331	1.2791	46.726	46.914	18.396	18.470	0.3206	0.0406	0.0055	0.9932	78.46	81.00
10	32.3	0.0	65.48	69.96	0.5225	0.4530	1.0645	1.3219	48.763	48.857	19.198	19.235	0.3386	0.0680	0.0093	0.9885	75.37	78.81
11	39.3	0.0	65.66	69.71	0.5456	0.4694	1.0241	1.3535	50.800	50.800	20.000	20.000	0.3954	0.1240	0.0178	0.9773	63.25	68.72

SL	V-1 FT/SEC	V-2 FT/SEC	VM-1 FT/SEC	VM-2 FT/SEC	VO-1 FT/SEC	VO-2 FT/SEC	U-1 FT/SEC	U-2 FT/SEC	V'-1 FT/SEC	V'-2 FT/SEC	VO'-1 FT/SEC	VO'-2 FT/SEC	RHOVM-1 LBM/FT2SEC	RHOVM-2 LBM/FT2SEC	EPSI-1 DEGREE	EPSI-2 DEGREE	PCT TE SPAN
1	923.9	699.3	722.9	699.3	575.3	0.0	928.4	957.1	804.5	1185.4	-353.2	-957.1	62.12	63.70	10.864	2.608	0.0000
2	855.1	704.0	704.8	704.0	484.2	0.0	990.6	1016.4	867.9	1236.4	-506.4	-1016.4	62.23	65.59	8.547	2.443	0.1000
3	797.9	680.7	675.8	680.7	424.2	0.0	1052.8	1075.7	923.0	1273.0	-628.6	-1075.7	60.63	64.07	6.747	2.190	0.2000
4	749.1	648.6	642.2	648.6	385.6	0.0	1114.9	1135.0	971.8	1307.2	-729.3	-1135.0	58.11	61.24	5.317	1.922	0.3000
5	707.7	615.3	610.2	615.3	358.4	0.0	1177.1	1194.3	1021.0	1343.5	-818.7	-1194.3	55.50	58.10	4.164	1.669	0.4000
6	673.2	586.8	582.3	586.8	337.9	0.0	1239.2	1253.6	1073.1	1384.1	-901.3	-1253.6	53.17	55.40	3.231	1.437	0.5000
7	644.3	562.8	557.6	562.8	322.9	0.0	1301.4	1312.8	1126.2	1428.4	-978.5	-1312.8	51.04	53.10	2.463	1.214	0.6000
8	624.1	546.6	538.6	546.6	315.2	0.0	1363.5	1372.1	1178.6	1477.0	-1048.3	-1372.1	49.36	51.49	1.809	0.983	0.7000
9	615.9	539.0	527.9	539.0	317.2	0.0	1425.7	1431.4	1227.7	1529.5	-1108.4	-1431.4	48.36	50.60	1.224	0.734	0.8000
10	623.3	543.8	527.0	543.8	332.7	0.0	1487.8	1490.7	1269.7	1586.8	-1155.2	-1490.7	48.13	50.70	0.671	0.455	0.9000
11	661.3	573.1	511.6	573.1	419.1	0.0	1550.0	1550.0	1241.2	1652.5	-1130.9	-1550.0	45.47	51.64	-0.000	-0.000	1.0000

WC1/A1 LBM/SEC SQFT	WC1/A1 KG/SEC SQM	TO/TO INLET	PO/PO INLET	EFF-AD INLET %	EFF-P INLET %	TO2/TO1	PO2/PO1	EFF-AD ROTOR %	EFF-P ROTOR %
33.04	161.32	1.2003	1.6691	78.65	80.12	1.6691	0.9866	80.68	168.97

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APPENDIX B
AIRFOIL GEOMETRY

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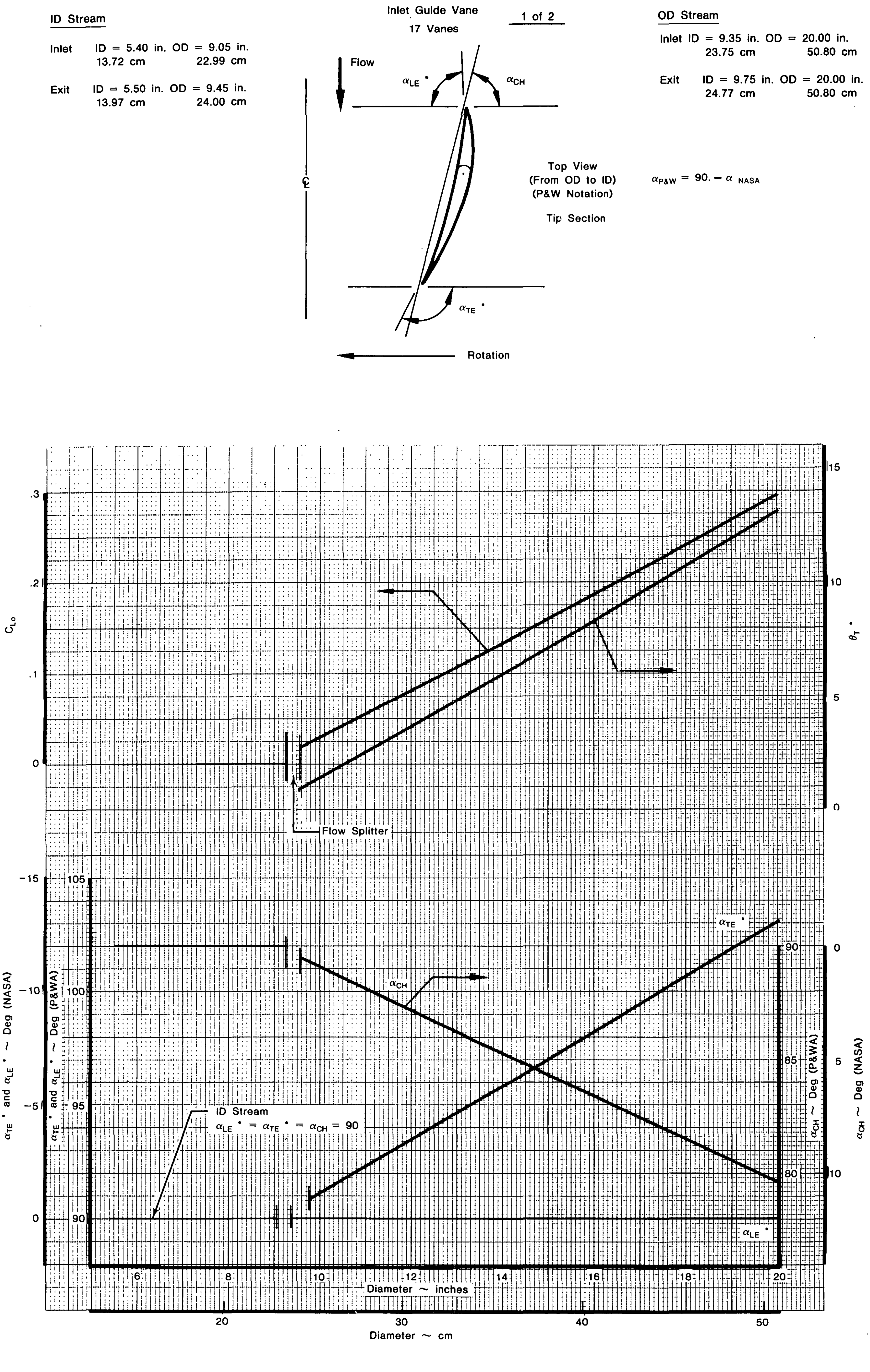

Figure 84. V/STOL Fan, IGV, 1 of 2

FD 268968

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ID Stream		OD Stream
Inlet	Inlet Guide Vane 2 of 2 17 Vanes	Inlet
ID = 5.40 in. OD = 9.05 in. 13.72 cm 22.99 cm		ID = 9.35 in. OD = 20.00 in. 23.75 cm 50.80 cm
Exit		Exit
ID = 5.50 in. OD = 9.45 in. 13.97 cm 24.00 cm		ID = 9.75 in. OD = 20.00 in. 24.77 cm 50.80 cm

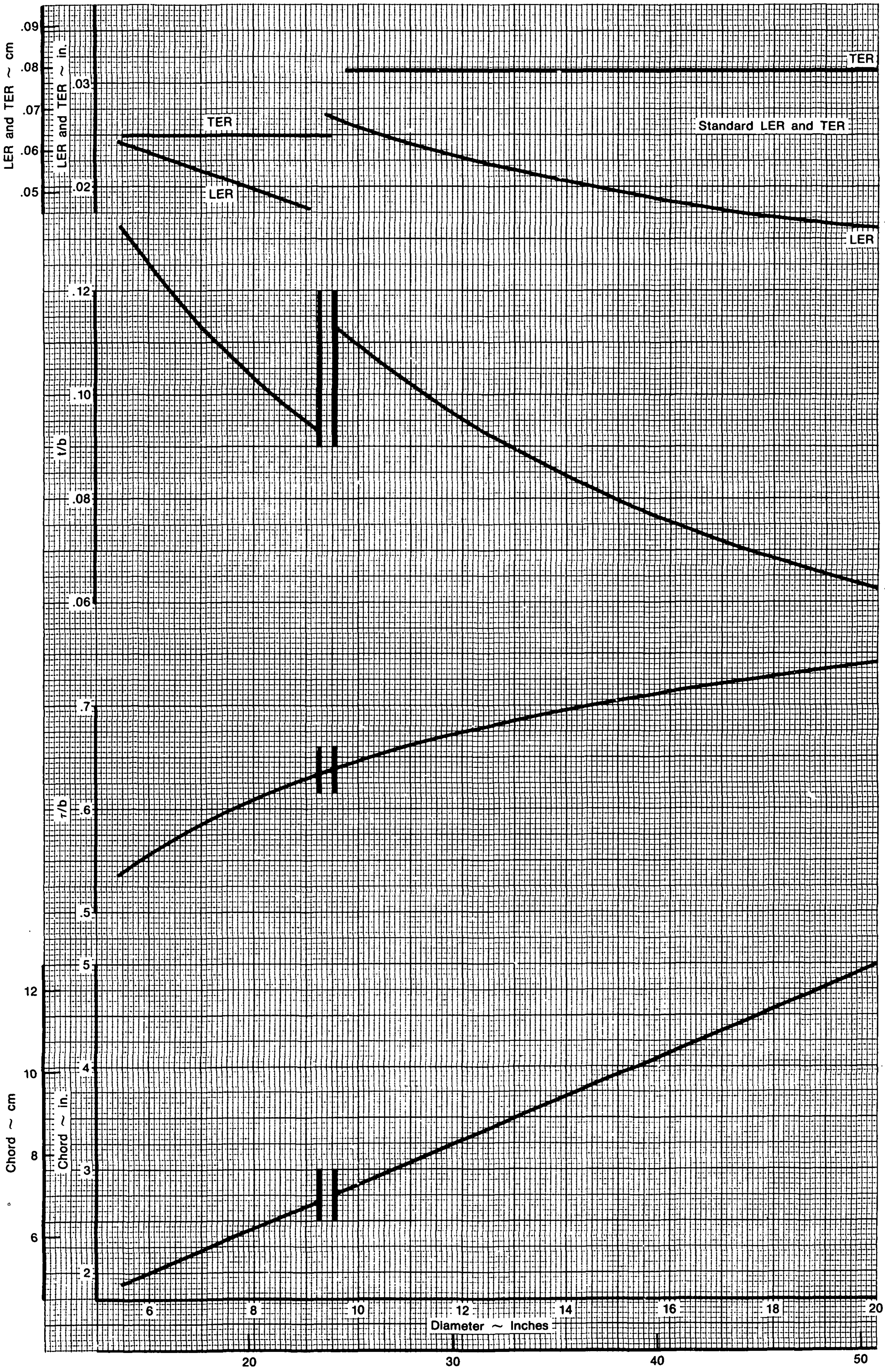

Figure 85. V/STOL Fan, IGV, 2 of 2

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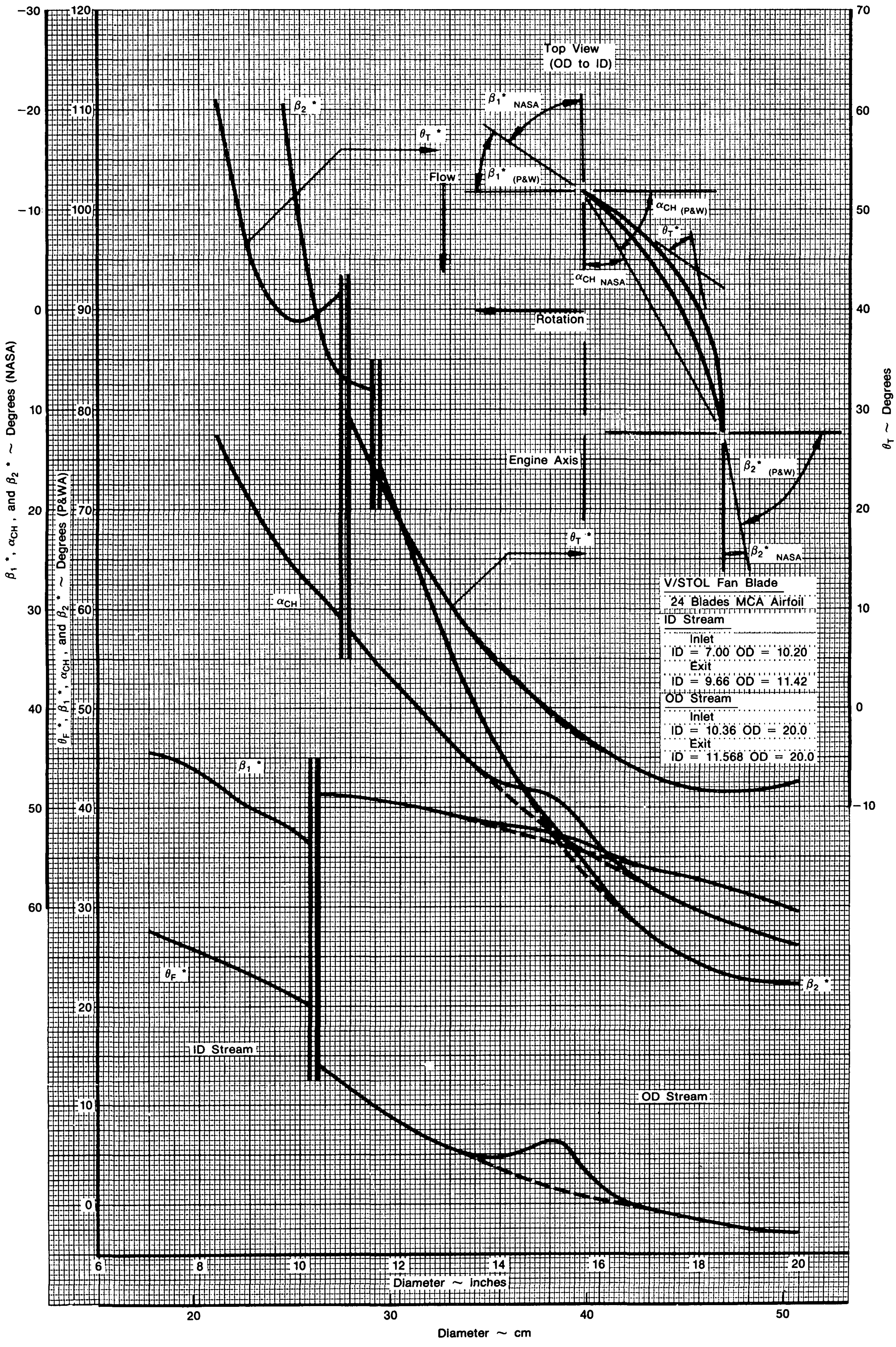

Figure 86. V/STOL Fan Blade, 1 of 2

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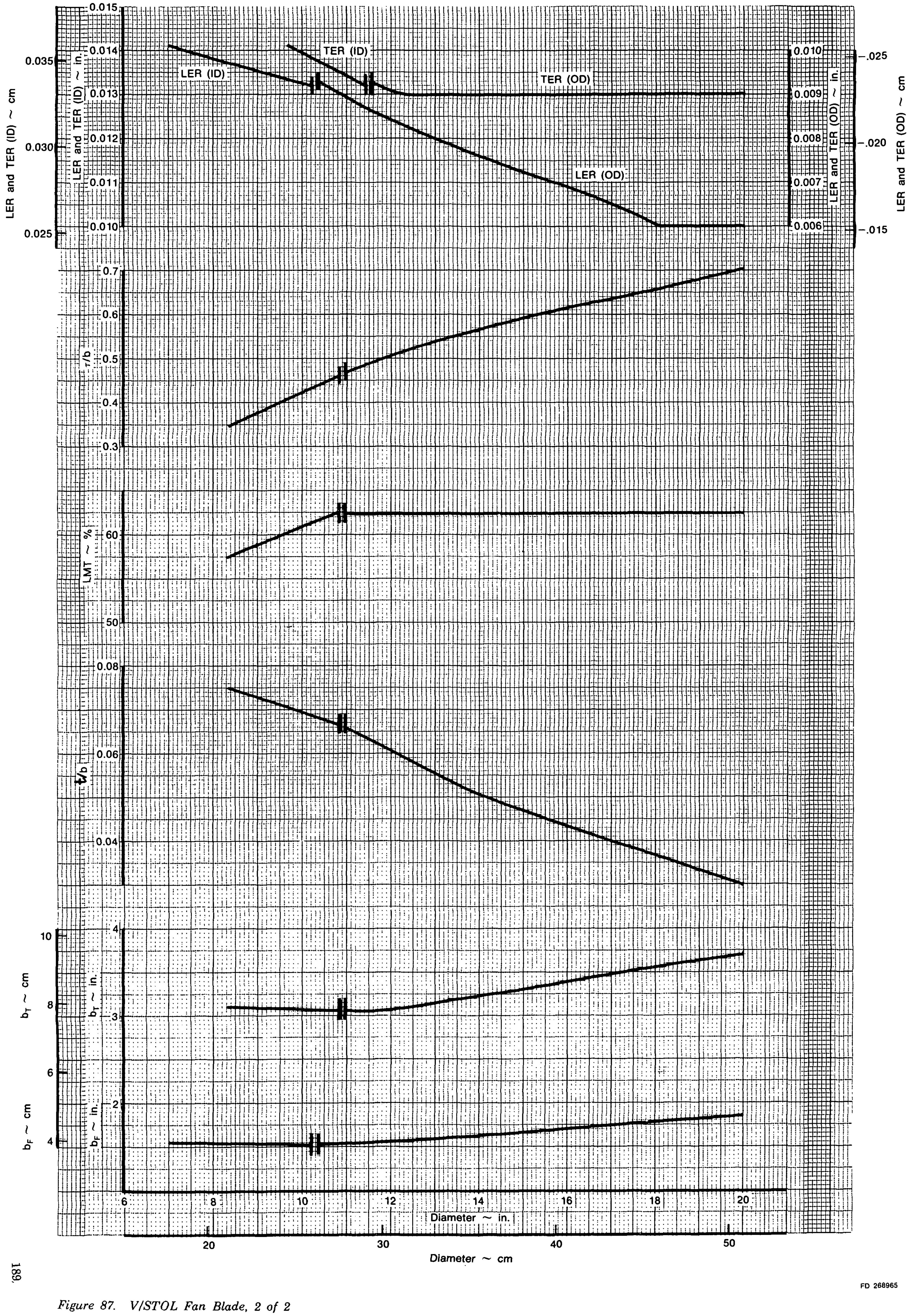

Figure 87. V/STOL Fan Blade, 2 of 2

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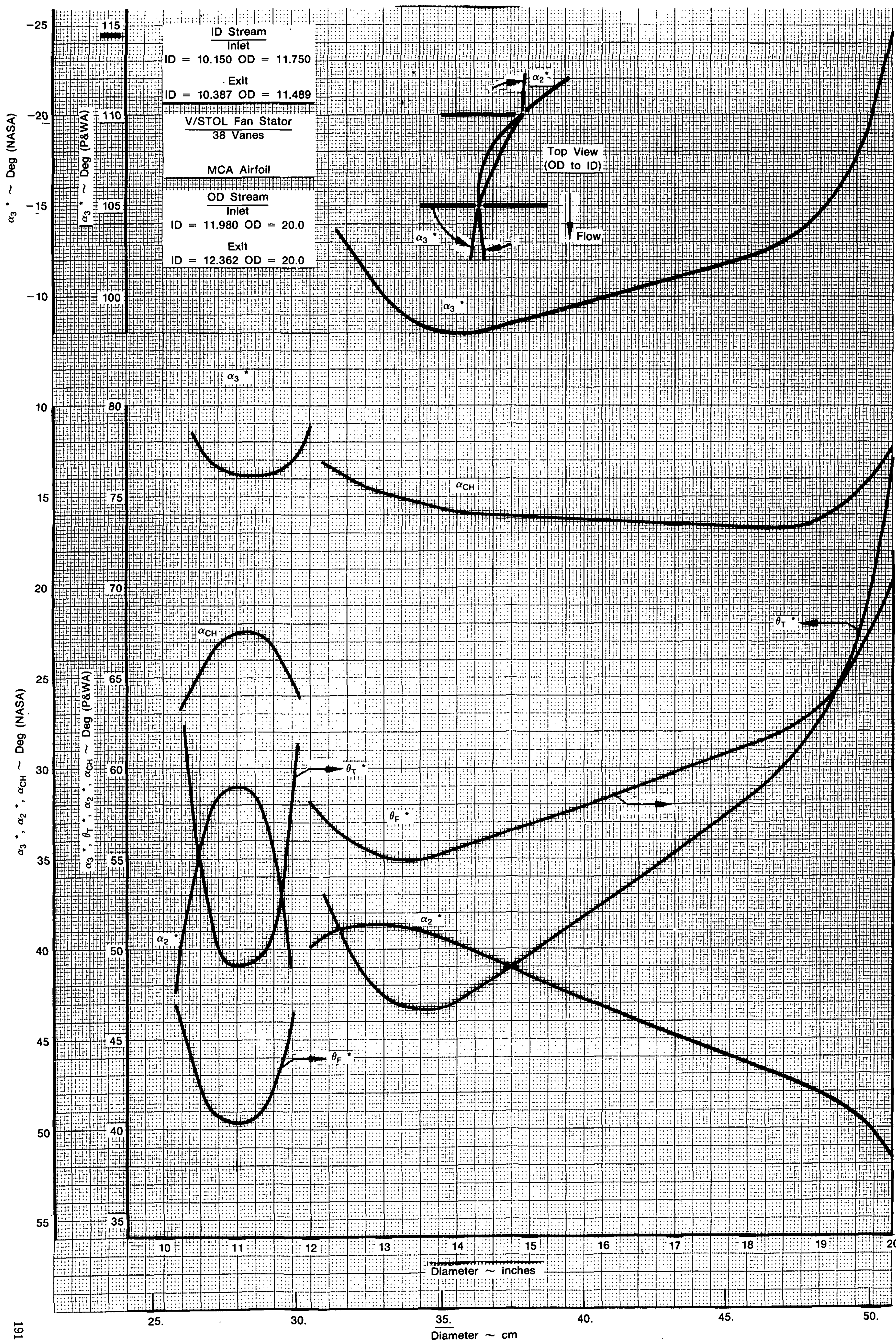

Figure 88. V/STOL Fan Stator, 1 of 2

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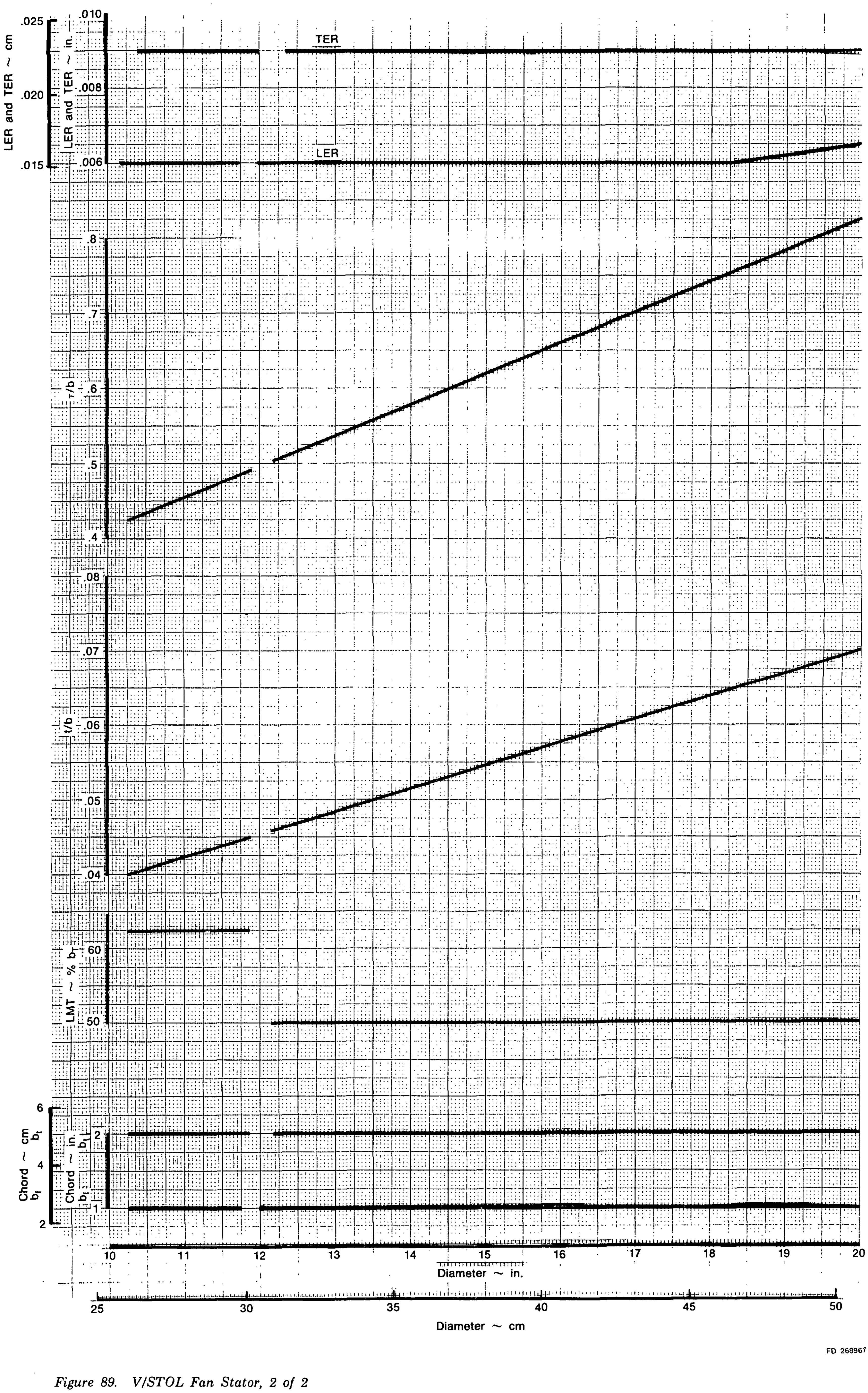

Figure 89. V/STOL Fan Stator, 2 of 2

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APPENDIX C
AIRFOIL SECTION COORDINATES

The airfoil section coordinate printouts are explained in Table 41 and Figure 90.

TABLE 41. — AIRFOIL SECTION COORDINATE PRINTOUT FORMAT

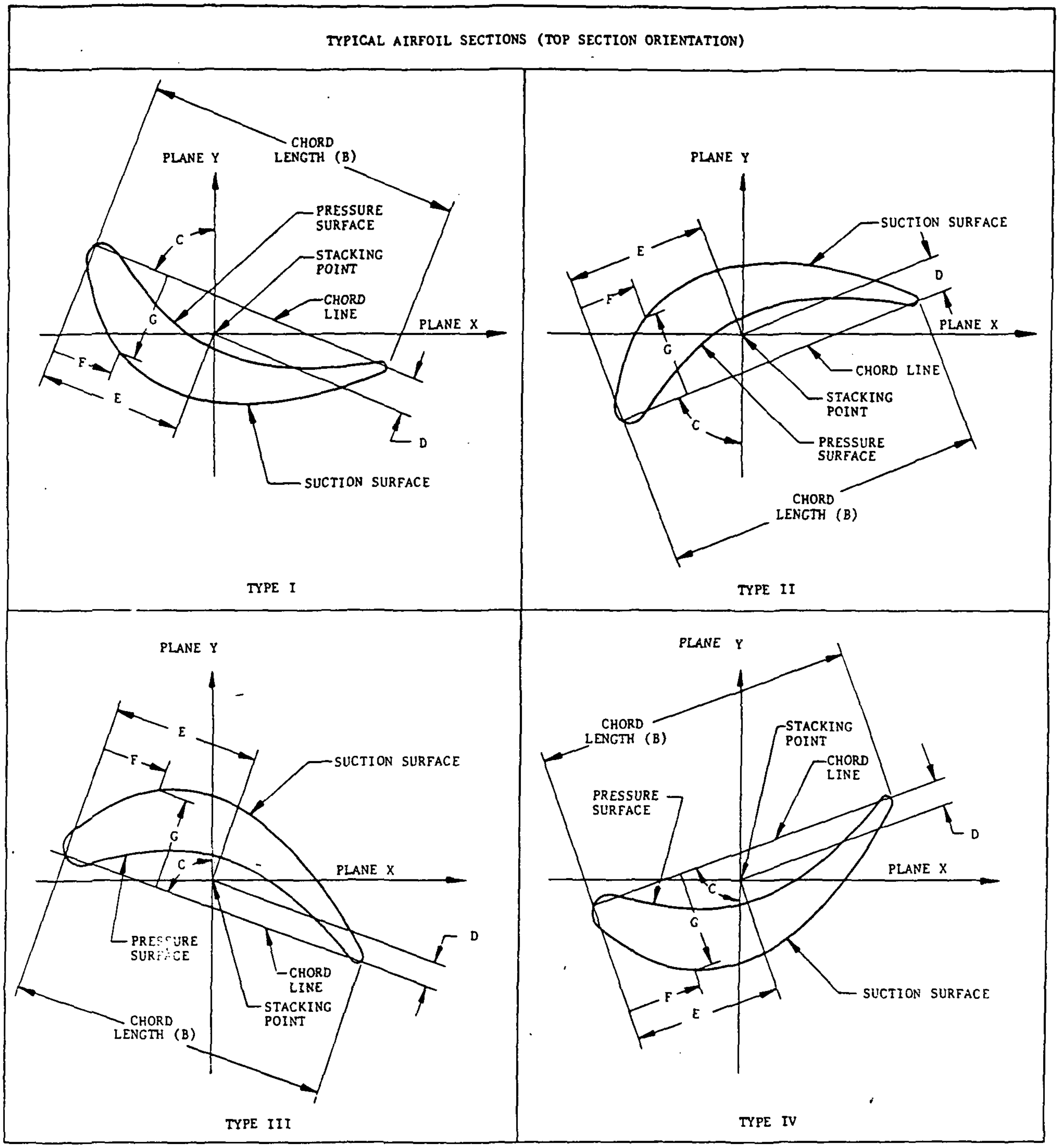
PWA 390 REVISION B

CARD	ITEM	DATA FIELD CODE	FORMAT CODE
1 thru 9	United Technologies Corporation Document Property Rights Notice	1-80	20A4
10	Computer file identification:		
	FILENAME	1-8	2A4
	FILETYPE	11-18	2A4
11	Identifying title (Title, stage, file category, EMD number . . .)	1-64	16A4
12	Total number of airfoil defining sections	1-5	I5
	Number of points along each surface	6-10	I5
	Airfoil orientation indicator: 1 = Type I 2 = Type II 3 = Type III 4 = Type IV	11-15	I5
	Rotation indicator (Blank or 0 = Std P&WA; 1 = Counter rotating)	16-20	I5
	Indicator for type of leading edge and trailing edge: 0 or Blank = circular arc LE and TE 1 = Elliptical LE, circular arc TE 2 = Elliptical TE, circular arc LE 3 = Elliptical LE and elliptical TE	26-30	I5
13*	First card of each airfoil defining section:		
	Title identifying this section (e.g., "A-A")	4-10	A4,A3
	"A" -dimension (basic distance locating the airfoil section from a reference base plane)	11-20	F10.4
	Chord length (length of line from leading edge reference point to trailing edge reference point)(B dim)	21-30	F10.6
	Coordinate of the stacking point along the G-axis (D dim)	31-40	F10.6
	Coordinate the stacking point along the F-axis (E dim)	41-50	F10.6
	Angle of the chord line measured from Plane Y (C dim)	51-60	F10.5
14*	Second card of each airfoil defining section:		
	Leading edge radius or ellipse semi-major axis at LE (reference only)	1-10	F10.6
	F dimension to center of LE circle or ellipse	11-20	F10.6
	G dimension to center of LE circle or ellipse	21-30	F10.6
	Trailing edge radius or ellipse semi-major axis at TE (reference only)	31-40	F10.6
	F dimension to center of TE circle or ellipse	41-50	F10.6
	G dimension to center of TE circle or ellipse	51-60	F10.6
14A**	Semi-minor axis of ellipse at leading edge	1-10	F10.6
	Angle# orienting ellipse at leading edge (ref only)	11-20	F10.5
	Semi-minor axis of ellipse at trailing edge	21-30	F10.6
	Angle# orienting ellipse at trailing edge (ref only)	31-40	F10.5
15*	Third block of data for each airfoil defining section: (Four sets of airfoil surface coordinate data)		
	The first point is the point of tangency between the leading edge circle or ellipse and the airfoil surface. The points continue along the surface to the last point which is the point of tangency between the trailing edge circle or ellipse and the airfoil surface. Values of each set are written 8 to a card in the columns and format shown at the right. The four sets of data are: Set 1: All the F-coordinate suction values Set 2: All the G-coordinate suction values Set 3: All the F-coordinate pressure values Set 4: All the G-coordinate pressure values	1-10 11-20 21-30 31-40 41-50 51-60 61-70 71-80	F10.6 F10.6 F10.6 F10.6 F10.6 F10.6 F10.6 F10.6

* Cards 13, 14, 14A, and 15-thru-As-Req'd repeat for the number of airfoil defining sections in the file.

** Card 14A appears in file only if the indicator for the type of leading and trailing edge is 1, 2, or 3. There will be a card 14A for each card 14.

\# Decimal degrees.



These views (looking radially inward) identify typical pressure and suction surfaces and airfoil orientation data. Direction of arrows for F & G coordinates indicate positive (+) values

FD 269064

Figure 90. Typical Airfoil Sections

CA131000.N22354E

TITLE

CASE-INLET GUIDE VANE,FRONT (I.D.) CAT 1 P/N4060676 NO REV EMD4060676 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830811	R.L.SANFORD	830811

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
31154B			237442	1	4060676 NO REV	4060676 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

CASE-INLET GUIDE VANE,FRONT I.D. CAT 1 P/N4060676 NO REV EMD4060676 NO REV

7 50	3	0					
A-A	* 2.7000	1.149019	0.000000	-0.051240	90.00008		
0.012053	0.012053	-0.000000	0.102898	1.046122	-0.000002		
0.001393	0.003921	0.006679	0.009667	0.012999	0.016676	0.020813	0.030236
0.039888	0.049655	0.059538	0.069647	0.090091	0.110766	0.131555	0.152459
0.173478	0.194612	0.215861	0.237110	0.258358	0.292701	0.319463	0.346225
0.372987	0.399749	0.426626	0.453502	0.480379	0.507256	0.534133	0.561010
0.587887	0.614878	0.641870	0.668862	0.695853	0.722845	0.749837	0.776713
0.803590	0.830467	0.857344	0.884221	0.911097	0.937974	0.964851	0.991728
1.018537	1.056714						
0.005625	0.010313	0.014900	0.019246	0.023408	0.027266	0.030584	0.035814
0.040575	0.045066	0.049216	0.052938	0.059759	0.065864	0.071334	0.076299
0.080810	0.085004	0.088871	0.092480	0.095876	0.100901	0.104371	0.107497
0.110331	0.112906	0.115136	0.117242	0.119014	0.120461	0.121742	0.122867
0.123678	0.124049	0.124393	0.124570	0.124498	0.124192	0.123632	0.122783
0.121679	0.120335	0.118786	0.117083	0.115255	0.113263	0.111088	0.108696
0.106164	0.102348						
0.001393	0.003921	0.006679	0.009667	0.012999	0.016676	0.020813	0.030236
0.039888	0.049655	0.059538	0.069647	0.090091	0.110766	0.131555	0.152459
0.173478	0.194612	0.215861	0.237110	0.258358	0.292701	0.319463	0.346225
0.372987	0.399749	0.426626	0.453502	0.480379	0.507256	0.534133	0.561010
0.587887	0.614878	0.641870	0.668862	0.695853	0.722845	0.749837	0.776713
0.803590	0.830467	0.857344	0.884221	0.911097	0.937974	0.964851	0.991728
1.018537	1.056714						
-0.005625	-0.010314	-0.014900	-0.019246	-0.023408	-0.027266	-0.030584	-0.035815
-0.040575	-0.045067	-0.049216	-0.052939	-0.059760	-0.065864	-0.071334	-0.076300
-0.080811	-0.085005	-0.088872	-0.092481	-0.095877	-0.100902	-0.104372	-0.107498
-0.110332	-0.112907	-0.115137	-0.117243	-0.119015	-0.120463	-0.121744	-0.122869
-0.123680	-0.124050	-0.124395	-0.124572	-0.124500	-0.124194	-0.123634	-0.122786
-0.121682	-0.120337	-0.118789	-0.117086	-0.115258	-0.113266	-0.111091	-0.108699
-0.106167	-0.102351						

* This dimension is the radial distance from the rig centerline to the airfoil manufacturing cross section. For further definition, see drawing T4060676, Sheet 1.

B-B	2.8600	1.168839	-0.000000	-0.010770	89.99991		
0.019485	0.019485	0.000000	0.105282	1.063558	0.000001		
0.003085	0.006124	0.009397	0.012904	0.016761	0.021086	0.025762	0.035464
0.045283	0.055335	0.065505	0.075791	0.096596	0.117519	0.138675	0.159948
0.181221	0.202611	0.224001	0.245507	0.267014	0.301963	0.328963	0.356080
0.383198	0.410315	0.437432	0.464549	0.491783	0.519018	0.546252	0.573486
0.600720	0.627954	0.655188	0.682422	0.709657	0.736891	0.764125	0.791359
0.818593	0.845827	0.873061	0.900295	0.927530	0.954647	0.981764	1.008957
1.036066	1.074010						
0.010521	0.015082	0.019276	0.023228	0.026967	0.030214	0.033011	0.038008
0.042629	0.046876	0.050800	0.054359	0.060962	0.066831	0.072135	0.077010
0.081398	0.085480	0.089248	0.092799	0.096121	0.101095	0.104509	0.107603
0.110419	0.112965	0.115211	0.117274	0.119071	0.120590	0.121920	0.123054
0.123880	0.124393	0.124770	0.124982	0.125024	0.124824	0.124380	0.123686
0.122732	0.121533	0.120116	0.118532	0.116801	0.114960	0.112957	0.110750
0.108367	0.104762						
0.003085	0.006124	0.009397	0.012904	0.016761	0.021086	0.025762	0.035464
0.045283	0.055335	0.065505	0.075791	0.096596	0.117519	0.138675	0.159948
0.181221	0.202611	0.224001	0.245507	0.267014	0.301963	0.328963	0.356080
0.383198	0.410315	0.437432	0.464549	0.491783	0.519018	0.546252	0.573486
0.600720	0.627954	0.655188	0.682422	0.709657	0.736891	0.764125	0.791359
0.818593	0.845827	0.873061	0.900295	0.927530	0.954647	0.981764	1.008957
1.036066	1.074011						
-0.010521	-0.015082	-0.019276	-0.023228	-0.026967	-0.030214	-0.033011	-0.038008
-0.042628	-0.046876	-0.050800	-0.054359	-0.060962	-0.066830	-0.072134	-0.077010
-0.081398	-0.085479	-0.089247	-0.092798	-0.096121	-0.101094	-0.104508	-0.107602
-0.110418	-0.112964	-0.115210	-0.117273	-0.119070	-0.120588	-0.121918	-0.123053
-0.123878	-0.124392	-0.124769	-0.124980	-0.125023	-0.124823	-0.124379	-0.123684
-0.122730	-0.121531	-0.120113	-0.118530	-0.116799	-0.114957	-0.112955	-0.110748
-0.108365	-0.104759						
C-C	3.2350	1.204175	-0.000000	0.075280	90.00008		
0.019287	0.019287	-0.000000	0.110263	1.093912	-0.000002		
0.003518	0.006770	0.010262	0.014116	0.018331	0.022907	0.027724	0.037720
0.047956	0.058313	0.068789	0.079384	0.100815	0.122367	0.144039	0.165832
0.187745	0.209658	0.231692	0.253725	0.275759	0.311759	0.339451	0.367143
0.394835	0.422648	0.450461	0.478274	0.506086	0.533899	0.561712	0.589525
0.617458	0.645391	0.673324	0.701257	0.729190	0.757123	0.785056	0.812989
0.840923	0.868856	0.896789	0.924602	0.952414	0.980227	1.008023	1.035901
1.063779	1.102787						
0.011106	0.015547	0.019564	0.023527	0.027204	0.030255	0.032896	0.037709
0.042205	0.046287	0.050112	0.053546	0.059921	0.065634	0.070795	0.075515
0.079821	0.083824	0.087563	0.090998	0.094260	0.099193	0.102624	0.105722
0.108544	0.111131	0.113494	0.115559	0.117479	0.119224	0.120616	0.121811
0.122879	0.123774	0.124383	0.124662	0.124926	0.125056	0.124947	0.124626
0.124097	0.123325	0.122321	0.121121	0.119742	0.118202	0.116551	0.114791
0.112860	0.109902						
0.003518	0.006770	0.010262	0.014116	0.018331	0.022907	0.027724	0.037720
0.047956	0.058313	0.068788	0.079384	0.100815	0.122367	0.144039	0.165832
0.187745	0.209658	0.231692	0.253725	0.275758	0.311758	0.339451	0.367143
0.394835	0.422648	0.450461	0.478274	0.506086	0.533899	0.561712	0.589524
0.617458	0.645391	0.673324	0.701257	0.729190	0.757123	0.785056	0.812989
0.840923	0.868856	0.896789	0.924601	0.952414	0.980227	1.008023	1.035901
1.063779	1.102786						
-0.011106	-0.015547	-0.019564	-0.023527	-0.027204	-0.030255	-0.032897	-0.037710
-0.042206	-0.046287	-0.050112	-0.053546	-0.059921	-0.065634	-0.070795	-0.075515
-0.079822	-0.083824	-0.087564	-0.090998	-0.094261	-0.099194	-0.102625	-0.105723
-0.108545	-0.111132	-0.113496	-0.115561	-0.117481	-0.119226	-0.120617	-0.121813
-0.122881	-0.123776	-0.124385	-0.124664	-0.124929	-0.125058	-0.124949	-0.124629
-0.124100	-0.123328	-0.122324	-0.121123	-0.119745	-0.118205	-0.116554	-0.114794
-0.112864	-0.109906						

D-D	3.6100	1.232330	0.000000	0.156240	89.99991		
0.018419	0.018419	0.000000	0.113751	1.118579	0.000002		
0.003725	0.007176	0.010996	0.015063	0.019500	0.024307	0.029360	0.039712
0.050188	0.060787	0.071506	0.082348	0.104278	0.126331	0.148508	0.170807
0.193107	0.215530	0.237953	0.260376	0.282922	0.319760	0.347973	0.376186
0.404523	0.432860	0.461196	0.489533	0.517870	0.546206	0.574543	0.602880
0.631216	0.659676	0.688136	0.716596	0.745056	0.773515	0.801975	0.830435
0.858895	0.887355	0.915815	0.944275	0.972734	1.001069	1.029488	1.057906
1.086325	1.125576						
0.011106	0.015476	0.019531	0.023420	0.026964	0.029887	0.032485	0.037128
0.041437	0.045354	0.049061	0.052372	0.058509	0.064038	0.069050	0.073642
0.077834	0.081728	0.085376	0.088731	0.091902	0.096756	0.100149	0.103252
0.106089	0.108690	0.111086	0.113262	0.115164	0.116992	0.118599	0.119910
0.121052	0.122095	0.122991	0.123627	0.123917	0.124190	0.124389	0.124375
0.124174	0.123796	0.123213	0.122400	0.121399	0.120221	0.118892	0.117423
0.115852	0.113535						
0.003725	0.007176	0.010996	0.015063	0.019500	0.024307	0.029360	0.039712
0.050188	0.060787	0.071506	0.082348	0.104278	0.126331	0.148508	0.170807
0.193107	0.215530	0.237953	0.260376	0.282922	0.319760	0.347973	0.376186
0.404523	0.432860	0.461196	0.489533	0.517870	0.546206	0.574543	0.602880
0.631216	0.659676	0.688136	0.716596	0.745056	0.773515	0.801975	0.830435
0.858895	0.887355	0.915815	0.944275	0.972734	1.001069	1.029488	1.057906
1.086325	1.125576						
-0.011106	-0.015476	-0.019531	-0.023420	-0.026964	-0.029887	-0.032485	-0.037128
-0.041437	-0.045354	-0.049061	-0.052372	-0.058509	-0.064038	-0.069050	-0.073642
-0.077833	-0.081727	-0.085375	-0.088730	-0.091902	-0.096755	-0.100148	-0.103251
-0.106088	-0.108689	-0.111085	-0.113261	-0.115162	-0.116991	-0.118598	-0.119908
-0.121051	-0.122093	-0.122989	-0.123625	-0.123915	-0.124188	-0.124387	-0.124373
-0.124172	-0.123793	-0.123210	-0.122398	-0.121397	-0.120218	-0.118889	-0.117420
-0.115849	-0.113532						
E-E	3.9850	1.254807	-0.000001	0.230170	90.00014		
0.017657	0.017657	-0.000000	0.117210	1.137596	-0.000003		
0.003836	0.007475	0.011365	0.015632	0.020275	0.025169	0.030314	0.040855
0.051522	0.062314	0.073230	0.084271	0.106604	0.129063	0.151647	0.174231
0.196941	0.219651	0.242486	0.265321	0.288156	0.325671	0.354277	0.383010
0.411742	0.440474	0.469206	0.497938	0.526670	0.555402	0.584260	0.613117
0.641975	0.670833	0.699690	0.728548	0.757405	0.786263	0.815121	0.843978
0.872836	0.901693	0.930551	0.959409	0.988266	1.017051	1.045910	1.074769
1.103628	1.143790						
0.010988	0.015340	0.019258	0.023151	0.026663	0.029482	0.032001	0.036511
0.040692	0.044496	0.048140	0.051386	0.057346	0.062750	0.067660	0.072146
0.076288	0.080094	0.083688	0.087028	0.090124	0.094919	0.098293	0.101427
0.104290	0.106921	0.109337	0.111585	0.113617	0.115413	0.117168	0.118696
0.119959	0.121067	0.122088	0.122987	0.123675	0.124018	0.124280	0.124530
0.124612	0.124518	0.124262	0.123841	0.123226	0.122425	0.121447	0.120303
0.119021	0.117042						
0.003835	0.007475	0.011365	0.015631	0.020275	0.025169	0.030314	0.040855
0.051522	0.062314	0.073230	0.084271	0.106604	0.129063	0.151647	0.174231
0.196941	0.219650	0.242486	0.265321	0.288156	0.325671	0.354277	0.383009
0.411742	0.440474	0.469206	0.497938	0.526670	0.555402	0.584260	0.613117
0.641975	0.670833	0.699690	0.728548	0.757405	0.786263	0.815121	0.843978
0.872836	0.901693	0.930551	0.959408	0.988266	1.017050	1.045909	1.074768
1.103627	1.143789						
-0.010988	-0.015340	-0.019258	-0.023151	-0.026663	-0.029482	-0.032001	-0.036511
-0.040692	-0.044496	-0.048141	-0.051386	-0.057347	-0.062751	-0.067661	-0.072147
-0.076289	-0.080096	-0.083690	-0.087030	-0.090125	-0.094920	-0.098295	-0.101429
-0.104293	-0.106923	-0.109340	-0.111587	-0.113620	-0.115416	-0.117171	-0.118699
-0.119962	-0.121071	-0.122091	-0.122991	-0.123679	-0.124022	-0.124284	-0.124534
-0.124616	-0.124522	-0.124266	-0.123846	-0.123232	-0.122430	-0.121452	-0.120309
-0.119027	-0.117048						

F-F	4.3600	1.269171	0.000000	0.297050	89.99991		
0.017380	0.017380	0.000000	0.119788	1.149383	0.000001		
0.004123	0.007931	0.011993	0.016435	0.021131	0.026209	0.031413	0.042202
0.053117	0.064160	0.075200	0.086367	0.108955	0.131543	0.154257	0.177099
0.199941	0.222909	0.245878	0.268847	0.291942	0.329885	0.358818	0.387750
0.416683	0.445616	0.474549	0.503482	0.532541	0.561601	0.590661	0.619720
0.648780	0.677840	0.706900	0.735959	0.765019	0.794079	0.823138	0.852198
0.881258	0.910317	0.939377	0.968437	0.997497	1.026544	1.055590	1.084636
1.113682	1.154372						
0.011239	0.015411	0.019285	0.023090	0.026356	0.029070	0.031501	0.035879
0.039962	0.043678	0.047201	0.050353	0.056098	0.061304	0.066049	0.070427
0.074449	0.078184	0.081675	0.084956	0.088009	0.092689	0.096019	0.099129
0.102008	0.104649	0.107092	0.109350	0.111465	0.113374	0.115078	0.116741
0.118206	0.119429	0.120506	0.121502	0.122405	0.123143	0.123591	0.123842
0.124120	0.124309	0.124330	0.124203	0.123931	0.123506	0.122905	0.122141
0.121211	0.119684						
0.004123	0.007931	0.011993	0.016435	0.021131	0.026209	0.031413	0.042202
0.053117	0.064160	0.075200	0.086367	0.108955	0.131543	0.154257	0.177099
0.199941	0.222909	0.245878	0.268847	0.291942	0.329885	0.358818	0.387750
0.416683	0.445616	0.474549	0.503482	0.532541	0.561601	0.590661	0.619720
0.648780	0.677840	0.706900	0.735959	0.765019	0.794079	0.823138	0.852198
0.881258	0.910317	0.939377	0.968437	0.997497	1.026544	1.055590	1.084636
1.113682	1.154373						
-0.011239	-0.015411	-0.019285	-0.023090	-0.026356	-0.029070	-0.031501	-0.035879
-0.039962	-0.043678	-0.047200	-0.050353	-0.056098	-0.061304	-0.066049	-0.070427
-0.074448	-0.078183	-0.081675	-0.084956	-0.088009	-0.092688	-0.096018	-0.099128
-0.102007	-0.104648	-0.107091	-0.109348	-0.111464	-0.113372	-0.115076	-0.116739
-0.118204	-0.119427	-0.120505	-0.121500	-0.122403	-0.123141	-0.123589	-0.123840
-0.124118	-0.124307	-0.124328	-0.124200	-0.123929	-0.123503	-0.122903	-0.122138
-0.121208	-0.119681						
G-G	4.7300	1.275552	0.000001	0.355320	89.99976		
0.016782	0.016782	0.000000	0.122643	1.152909	0.000004		
0.004229	0.008184	0.012394	0.016858	0.021706	0.026808	0.032039	0.042882
0.053852	0.064823	0.075920	0.087145	0.109722	0.132426	0.155258	0.178091
0.201050	0.224010	0.246970	0.270057	0.293144	0.331283	0.360238	0.389192
0.418147	0.447102	0.476057	0.505139	0.534221	0.563303	0.592386	0.621468
0.650550	0.679633	0.708715	0.737797	0.766880	0.795962	0.825044	0.854126
0.883209	0.912291	0.941373	0.970456	0.999538	1.028586	1.057759	1.086805
1.115851	1.156537						
0.011139	0.015268	0.019135	0.022824	0.026088	0.028736	0.031087	0.035347
0.039306	0.042888	0.046304	0.049451	0.055015	0.060109	0.064764	0.069048
0.073002	0.076691	0.080102	0.083346	0.086386	0.091003	0.094292	0.097385
0.100287	0.102970	0.105444	0.107750	0.109893	0.111901	0.113726	0.115365
0.116960	0.118417	0.119630	0.120696	0.121673	0.122583	0.123372	0.123968
0.124282	0.124544	0.124800	0.124942	0.124945	0.124820	0.124565	0.124171
0.123604	0.122591						
0.004230	0.008184	0.012394	0.016858	0.021706	0.026809	0.032039	0.042882
0.053852	0.064823	0.075920	0.087145	0.109722	0.132426	0.155258	0.178091
0.201050	0.224010	0.246970	0.270057	0.293144	0.331283	0.360238	0.389192
0.418147	0.447102	0.476057	0.505139	0.534221	0.563304	0.592386	0.621468
0.650550	0.679633	0.708715	0.737797	0.766880	0.795962	0.825044	0.854127
0.883209	0.912291	0.941373	0.970456	0.999538	1.028586	1.057759	1.086805
1.115851	1.156538						
-0.011139	-0.015268	-0.019135	-0.022824	-0.026088	-0.028736	-0.031087	-0.035347
-0.039305	-0.042888	-0.046303	-0.049450	-0.055014	-0.060108	-0.064763	-0.069046
-0.073000	-0.076689	-0.080100	-0.083344	-0.086384	-0.091000	-0.094289	-0.097382
-0.100283	-0.102967	-0.105440	-0.107746	-0.109889	-0.111896	-0.113721	-0.115360
-0.116955	-0.118412	-0.119624	-0.120690	-0.121667	-0.122576	-0.123365	-0.123961
-0.124276	-0.124536	-0.124792	-0.124934	-0.124937	-0.124811	-0.124557	-0.124162
-0.123595	-0.122581						

TITLE

CASE-INLET GUIDE VANE,FRONT (O.D.) CAT 1 P/N4060676 NO REV EMD4060676 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830811	R.L.SANFORD	830811

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
311548			237442	1	4060676 NO REV	4060676 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

CASE-INLET GUIDE VANE,FRONT (O.D.) CAT 1 P/N4060676 NO REV END4060676 NO REV

11	50	3	0				
AA-AA	* 4.6800	1.308396	-0.002704	0.350610	89.37645		
0.024363	0.024362	0.000243	0.152894	1.155608	0.005686		
0.004702	0.008235	0.012029	0.016086	0.020404	0.024984	0.029956	0.040424
0.051023	0.061753	0.072612	0.083602	0.105974	0.128477	0.151242	0.174138
0.197033	0.220060	0.243217	0.266374	0.289532	0.328650	0.357826	0.387002
0.416177	0.445353	0.474659	0.503965	0.533272	0.562578	0.591885	0.621191
0.650498	0.679804	0.709241	0.738678	0.768116	0.797553	0.826990	0.856427
0.885865	0.915302	0.944739	0.974176	1.003609	1.033006	1.062403	1.091800
1.121197	1.161263						
0.014631	0.019329	0.023639	0.027872	0.031880	0.035381	0.038449	0.043918
0.048772	0.053381	0.057652	0.061745	0.069000	0.075621	0.081687	0.087323
0.092446	0.097341	0.101817	0.106026	0.110009	0.116258	0.120546	0.124630
0.128454	0.131987	0.135270	0.138305	0.141150	0.143787	0.146215	0.148430
0.150459	0.152407	0.154085	0.155552	0.156864	0.158036	0.159038	0.159848
0.160409	0.160774	0.161123	0.161366	0.161403	0.161261	0.160946	0.160451
0.159735	0.158473						
0.004918	0.008451	0.012246	0.016302	0.020620	0.025331	0.030303	0.040771
0.051501	0.062361	0.073351	0.084341	0.106844	0.129478	0.152243	0.175139
0.198165	0.221192	0.244349	0.267506	0.290664	0.329782	0.358958	0.388134
0.417309	0.446485	0.475791	0.505098	0.534404	0.563710	0.593017	0.622323
0.651630	0.680936	0.710243	0.739680	0.769117	0.798554	0.827991	0.857429
0.886866	0.916303	0.945740	0.975178	1.004608	1.034005	1.063402	1.092799
1.122196	1.162257						
-0.014437	-0.018994	-0.023184	-0.027290	-0.031186	-0.034692	-0.037668	-0.042948
-0.047669	-0.052133	-0.056264	-0.060166	-0.067114	-0.073416	-0.079153	-0.084466
-0.089318	-0.093912	-0.098097	-0.102030	-0.105753	-0.111556	-0.115526	-0.119306
-0.122823	-0.126066	-0.129063	-0.131829	-0.134393	-0.136766	-0.138944	-0.140883
-0.142682	-0.144423	-0.145829	-0.147043	-0.148115	-0.149082	-0.149909	-0.150525
-0.150804	-0.150970	-0.151147	-0.151177	-0.151007	-0.150668	-0.150171	-0.149486
-0.148578	-0.147062						

* This dimension is the radial distance from the rig centerline to the airfoil manufacturing cross section. For further definition, see drawing T4060676, Sheet 1.

AB-AB	4.8800	1.332395	-0.005988	0.402113	89.10313		
0.023767	0.023765	0.000324	0.153096	1.179393	0.005383		
0.004698	0.008296	0.012160	0.016291	0.020688	0.025485	0.030549	0.041209
0.052135	0.063195	0.074385	0.085575	0.108488	0.131535	0.154714	0.178027
0.201473	0.224919	0.248499	0.272078	0.295791	0.335622	0.365330	0.395037
0.424744	0.454584	0.484425	0.514265	0.544106	0.573946	0.603787	0.633761
0.663734	0.693708	0.723682	0.753655	0.783629	0.813603	0.843576	0.873550
0.903524	0.933497	0.963471	0.993445	1.023436	1.053394	1.083353	1.113312
1.143270	1.184739						
0.014514	0.019216	0.023505	0.027739	0.031751	0.035343	0.038369	0.043826
0.048727	0.053382	0.057676	0.061775	0.069013	0.075633	0.081686	0.087265
0.092444	0.097252	0.101729	0.105952	0.109957	0.116108	0.120409	0.124460
0.128256	0.131797	0.135058	0.138090	0.140905	0.143544	0.145964	0.148133
0.150214	0.152182	0.153805	0.155229	0.156524	0.157737	0.158807	0.159651
0.160121	0.160474	0.160849	0.161094	0.161142	0.161021	0.160740	0.160282
0.159605	0.158385						
0.004999	0.008730	0.012728	0.016992	0.021522	0.026319	0.031516	0.042309
0.053236	0.064295	0.075485	0.086809	0.109722	0.132902	0.156214	0.179527
0.202973	0.226553	0.250132	0.273711	0.297424	0.337256	0.366963	0.396670
0.426377	0.456085	0.485925	0.515765	0.545606	0.575446	0.605287	0.635127
0.664968	0.694808	0.724782	0.754756	0.784729	0.814703	0.844677	0.874650
0.904624	0.934598	0.964571	0.994545	1.024530	1.054489	1.084448	1.114407
1.144365	1.185073						
-0.014261	-0.018921	-0.023161	-0.027318	-0.031226	-0.034605	-0.037538	-0.042756
-0.047379	-0.051743	-0.055781	-0.059680	-0.066469	-0.072698	-0.078377	-0.083594
-0.088396	-0.092910	-0.097066	-0.100975	-0.104671	-0.110369	-0.114340	-0.118070
-0.121570	-0.124806	-0.127799	-0.130575	-0.133152	-0.135562	-0.137748	-0.139709
-0.141606	-0.143326	-0.144777	-0.146051	-0.147218	-0.148295	-0.149211	-0.149868
-0.150201	-0.150496	-0.150751	-0.150855	-0.150803	-0.150591	-0.150220	-0.149667
-0.148901	-0.147605						
AC-AC	5.5000	1.397901	-0.014479	0.552343	88.26106		
0.022358	0.022351	0.000571	0.154286	1.243679	0.004465		
0.004785	0.008700	0.012894	0.017368	0.022121	0.027294	0.032746	0.044070
0.055674	0.067416	0.079297	0.091177	0.115358	0.139679	0.164139	0.188739
0.213479	0.238218	0.263098	0.287978	0.312857	0.354649	0.385958	0.417268
0.448577	0.479886	0.511335	0.542784	0.574232	0.605681	0.637130	0.668579
0.700028	0.731477	0.762926	0.794375	0.825963	0.857552	0.889141	0.920729
0.952318	0.983907	1.015436	1.047043	1.078650	1.110256	1.141863	1.173470
1.205076	1.247926						
0.014404	0.019182	0.023567	0.027917	0.031969	0.035522	0.038570	0.044020
0.048930	0.053589	0.057888	0.062007	0.069262	0.075870	0.081897	0.087512
0.092629	0.097487	0.101961	0.106133	0.110074	0.116220	0.120461	0.124452
0.128235	0.131745	0.134998	0.138006	0.140791	0.143392	0.145791	0.147982
0.149990	0.151823	0.153548	0.155057	0.156341	0.157478	0.158475	0.159318
0.159969	0.160442	0.160687	0.160820	0.160921	0.160890	0.160669	0.160277
0.159718	0.158691						
0.005328	0.009522	0.013856	0.018470	0.023503	0.028815	0.034407	0.045871
0.057614	0.069356	0.081237	0.093258	0.117578	0.142038	0.166638	0.191238
0.215978	0.240718	0.265458	0.290337	0.315217	0.357009	0.388178	0.419348
0.450517	0.481826	0.513135	0.544444	0.575754	0.607063	0.638372	0.669681
0.700990	0.732299	0.763608	0.794917	0.826366	0.857815	0.889264	0.920713
0.952162	0.983611	1.015002	1.046470	1.077937	1.109405	1.140872	1.172339
1.203807	1.246403						
-0.013925	-0.018644	-0.022806	-0.026900	-0.030770	-0.034021	-0.036826	-0.041769
-0.046273	-0.050451	-0.054331	-0.058041	-0.064547	-0.070466	-0.075866	-0.080904
-0.085489	-0.089877	-0.093877	-0.097650	-0.101230	-0.106838	-0.110682	-0.114335
-0.117810	-0.121066	-0.124100	-0.126916	-0.129550	-0.132028	-0.134334	-0.136469
-0.138420	-0.140226	-0.141985	-0.143511	-0.144849	-0.146056	-0.147148	-0.148119
-0.148938	-0.149571	-0.149967	-0.150310	-0.150632	-0.150816	-0.150832	-0.150697
-0.150393	-0.149795						

AD-AD	6.1100	1.454262	-0.020087	0.692153	87.44472		
0.021643	0.021628	0.000809	0.155265	1.299042	0.003734		
0.004944	0.009161	0.013670	0.018469	0.023560	0.029086	0.034904	0.046830
0.058901	0.071118	0.083480	0.095842	0.121148	0.146599	0.172196	0.197938
0.223680	0.249567	0.275455	0.301342	0.327375	0.370860	0.403438	0.436161
0.468884	0.501607	0.534330	0.567053	0.599776	0.632499	0.665367	0.698235
0.731104	0.763972	0.796840	0.829709	0.862577	0.895446	0.928314	0.961182
0.994051	1.026976	1.059881	1.092787	1.125692	1.158598	1.191504	1.224409
1.257315	1.302793						
0.014595	0.019358	0.023889	0.028334	0.032374	0.035850	0.038874	0.044330
0.049233	0.053896	0.058189	0.062333	0.069624	0.076244	0.082302	0.087917
0.093079	0.097881	0.102392	0.106563	0.110520	0.116597	0.120809	0.124778
0.128519	0.132033	0.135275	0.138259	0.141017	0.143565	0.145959	0.148150
0.150109	0.151929	0.153639	0.155120	0.156402	0.157501	0.158497	0.159373
0.160089	0.160565	0.160777	0.160911	0.160961	0.160890	0.160704	0.160378
0.159886	0.158950						
0.005830	0.010339	0.015138	0.020229	0.025610	0.031282	0.037245	0.049462
0.061824	0.074186	0.086694	0.099201	0.124652	0.150103	0.175700	0.201442
0.227184	0.252926	0.278814	0.304701	0.330589	0.374074	0.406506	0.438938
0.471370	0.503948	0.536525	0.569103	0.601680	0.634258	0.666835	0.699413
0.731990	0.764568	0.797145	0.829723	0.862300	0.895023	0.927746	0.960469
0.993192	1.025829	1.058445	1.091061	1.123676	1.156292	1.188908	1.221523
1.254139	1.299640						
-0.013985	-0.018480	-0.022701	-0.026781	-0.030406	-0.033415	-0.036081	-0.040834
-0.045146	-0.049122	-0.052824	-0.056346	-0.062510	-0.068107	-0.073238	-0.078053
-0.082485	-0.086645	-0.090567	-0.094234	-0.097715	-0.103152	-0.106946	-0.110528
-0.113951	-0.117218	-0.120278	-0.123151	-0.125847	-0.128392	-0.130806	-0.133060
-0.135144	-0.137124	-0.138999	-0.140715	-0.142287	-0.143716	-0.145062	-0.146305
-0.147416	-0.148323	-^.149051	-0.149709	-0.150276	-0.150751	-0.151146	-0.151421
-0.151543	-0.151528						
AE-AE	6.7300	1.505152	-0.022798	0.827682	86.61224		
0.020582	0.020556	0.001025	0.155953	1.349236	0.003417		
0.004978	0.009494	0.014310	0.019428	0.024847	0.030568	0.036589	0.049082
0.061727	0.074520	0.087463	0.100406	0.126744	0.153232	0.179871	0.206510
0.233299	0.260088	0.287028	0.313968	0.340908	0.385908	0.419770	0.453633
0.487496	0.521510	0.555523	0.589536	0.623550	0.657563	0.691577	0.725590
0.759603	0.793617	0.827781	0.861945	0.896108	0.930272	0.964436	0.998600
1.032745	1.066883	1.101021	1.135159	1.169296	1.203434	1.237572	1.271709
1.305847	1.352931						
0.014476	0.019315	0.023986	0.028537	0.032626	0.036071	0.039117	0.044614
0.049565	0.054296	0.058640	0.062840	0.070227	0.076883	0.082962	0.088616
0.093807	0.098614	0.103190	0.107354	0.111272	0.117383	0.121601	0.125489
0.129199	0.132715	0.135963	0.138959	0.141704	0.144231	0.146570	0.148728
0.150721	0.152502	0.154062	0.155565	0.156987	0.158063	0.158946	0.159694
0.160360	0.160936	0.161356	0.161535	0.161384	0.161181	0.160997	0.160702
0.160214	0.159326						
0.006161	0.011128	0.016246	0.021665	0.027385	0.033406	0.039578	0.052373
0.065167	0.078110	0.091204	0.104297	0.130786	0.157274	0.183913	0.210552
0.237341	0.264130	0.290920	0.317709	0.344498	0.389498	0.423211	0.456923
0.490635	0.524348	0.558060	0.591772	0.625485	0.659197	0.692910	0.726622
0.760334	0.794047	0.827759	0.861622	0.895485	0.929348	0.963211	0.997074
1.030927	1.064765	1.098603	1.132442	1.166280	1.200118	1.233956	1.267795
1.301633	1.348009						
-0.013684	-0.018177	-0.022316	-0.026277	-0.029742	-0.032629	-0.035165	-0.039649
-0.043714	-0.047490	-0.051008	-0.054368	-0.060245	-0.065532	-0.070393	-0.074991
-0.079223	-0.083243	-0.087026	-0.090545	-0.093901	-0.099231	-0.102946	-0.106448
-0.109838	-0.113080	-0.116152	-0.119065	-0.121818	-0.124431	-0.126910	-0.129271
-0.131518	-0.133613	-0.135562	-0.137501	-0.139354	-0.140977	-0.142473	-0.143879
-0.145232	-0.146517	-0.147682	-0.148657	-0.149399	-0.150122	-0.150854	-0.151495
-0.151996	-0.152529						

AF-AF	7.3500	1.544466	-0.022677	0.952081	85.80334		
0.019563	0.019523	0.001235	0.156087	1.388412	0.003212		
0.004905	0.009693	0.014636	0.019888	0.025448	0.031472	0.037651	0.050471
0.063600	0.076727	0.090009	0.103290	0.130316	0.157497	0.184832	0.212322
0.239811	0.267455	0.295099	0.322743	0.350542	0.396718	0.431466	0.466368
0.501271	0.536173	0.571076	0.605978	0.640881	0.675938	0.710994	0.746051
0.781108	0.816165	0.851222	0.886279	0.921336	0.956393	0.991450	1.026506
1.061514	1.096521	1.131529	1.166536	1.201544	1.236551	1.271559	1.306566
1.341574	1.390944						
0.014235	0.019178	0.023844	0.028403	0.032534	0.036102	0.039141	0.044681
0.049646	0.054414	0.058777	0.062966	0.070456	0.077129	0.083262	0.088914
0.094183	0.098979	0.103586	0.107798	0.111733	0.117791	0.121996	0.125920
0.129561	0.133025	0.136277	0.139265	0.142009	0.144529	0.146833	0.148969
0.150925	0.152697	0.154289	0.155689	0.156939	0.158134	0.159113	0.159848
0.160437	0.160900	0.161251	0.161466	0.161525	0.161402	0.161029	0.160562
0.160071	0.159278						
0.006393	0.011644	0.017051	0.022766	0.028790	0.035123	0.041610	0.054739
0.068022	0.081458	0.094894	0.108330	0.135510	0.162845	0.190181	0.217670
0.245160	0.272649	0.300139	0.327628	0.355272	0.401449	0.436042	0.470636
0.505229	0.539823	0.574416	0.609010	0.643604	0.678197	0.712791	0.747384
0.781978	0.816572	0.851165	0.885759	0.920352	0.954946	0.989694	1.024301
1.059001	1.093701	1.128402	1.163102	1.197803	1.232503	1.267203	1.301904
1.336604	1.384746						
-0.013266	-0.017629	-0.021672	-0.025524	-0.028875	-0.031642	-0.034055	-0.038274
-0.042084	-0.045656	-0.048913	-0.052085	-0.057606	-0.062588	-0.067163	-0.071488
-0.075564	-0.079333	-0.082996	-0.086387	-0.089632	-0.094771	-0.098409	-0.101858
-0.105156	-0.108357	-0.111434	-0.114371	-0.117177	-0.119851	-0.122408	-0.124866
-0.127218	-0.129462	-0.131602	-0.133626	-0.135573	-0.137492	-0.139276	-0.140919
-0.142481	-0.143964	-0.145373	-0.146693	-0.147912	-0.149009	-0.149946	-0.150827
-0.151692	-0.152830						
AG-AG	7.9700	1.578869	-0.019888	1.072438	85.02716		
0.018669	0.018609	0.001500	0.155300	1.423599	0.003086		
0.004793	0.009688	0.014899	0.020425	0.026268	0.032426	0.038900	0.052163
0.065585	0.079163	0.092742	0.106479	0.134268	0.162215	0.190320	0.218583
0.246845	0.275108	0.303529	0.331950	0.360370	0.407580	0.443264	0.478948
0.514789	0.550631	0.586473	0.622314	0.658156	0.693998	0.729839	0.765681
0.801523	0.837522	0.873522	0.909521	0.945521	0.981520	1.017460	1.053494
1.089529	1.125564	1.161598	1.197633	1.233667	1.269702	1.305737	1.341771
1.377806	1.426816						
0.014056	0.018938	0.023775	0.028479	0.032714	0.036257	0.039333	0.044929
0.049858	0.054681	0.059077	0.063281	0.070914	0.077590	0.083779	0.089449
0.094727	0.099583	0.104105	0.108398	0.112324	0.118360	0.122514	0.126370
0.130003	0.133391	0.136583	0.139559	0.142278	0.144750	0.147011	0.149061
0.150953	0.152691	0.154228	0.155556	0.156763	0.157868	0.158774	0.159500
0.160043	0.160449	0.160763	0.160956	0.161000	0.160826	0.160407	0.159892
0.159286	0.158352						
0.006684	0.012210	0.018053	0.024053	0.030369	0.036843	0.043474	0.057054
0.070791	0.084527	0.098422	0.112317	0.140264	0.168369	0.196473	0.224578
0.252683	0.280788	0.309051	0.337314	0.365577	0.412786	0.448154	0.483522
0.518890	0.554258	0.589626	0.624994	0.660362	0.695730	0.731098	0.766466
0.801834	0.837360	0.872886	0.908412	0.943937	0.979463	1.014938	1.050344
1.085749	1.121311	1.156874	1.192436	1.227999	1.263561	1.299124	1.334686
1.370249	1.418786						
-0.012865	-0.017023	-0.021038	-0.024722	-0.027885	-0.030427	-0.032652	-0.036633
-0.040179	-0.043482	-0.046521	-0.049488	-0.054665	-0.059301	-0.063601	-0.067616
-0.071457	-0.075037	-0.078479	-0.081773	-0.084886	-0.089831	-0.093334	-0.096701
-0.099947	-0.103081	-0.106127	-0.109070	-0.111899	-0.114623	-0.117251	-0.119784
-0.122239	-0.124622	-0.126901	-0.129081	-0.131209	-0.133287	-0.135261	-0.137143
-0.138933	-0.140667	-0.142356	-0.143979	-0.145516	-0.146926	-0.148196	-0.149418
-0.150605	-0.152139						

AH-AH	8.5800	1.605793	-0.014074	1.182718	84.26353		
0.017774	0.017691	0.001712	0.154854	1.450982	0.003665		
0.004621	0.009599	0.014899	0.020519	0.026461	0.032725	0.039309	0.052799
0.066609	0.080419	0.094389	0.108359	0.136620	0.165202	0.193945	0.222688
0.251592	0.280495	0.309559	0.338623	0.367687	0.415699	0.452150	0.488600
0.525051	0.561662	0.598273	0.634884	0.671495	0.708106	0.744717	0.781328
0.817939	0.854550	0.891162	0.927773	0.964384	1.000992	1.037682	1.074371
1.111061	1.147751	1.184441	1.221130	1.257820	1.294510	1.331200	1.367889
1.404579	1.455872						
0.013757	0.018636	0.023507	0.028263	0.032577	0.036224	0.039392	0.045060
0.050014	0.054894	0.059399	0.063613	0.071408	0.078201	0.084463	0.090159
0.095537	0.100455	0.105008	0.109407	0.113362	0.119349	0.123556	0.127473
0.131048	0.134378	0.137559	0.140536	0.143261	0.145747	0.147996	0.150014
0.151857	0.153520	0.155028	0.156384	0.157541	0.158471	0.159310	0.160156
0.160733	0.161043	0.161193	0.161239	0.161221	0.161119	0.160884	0.160467
0.159768	0.158440						
0.006897	0.012678	0.018781	0.025044	0.031628	0.038373	0.045279	0.059250
0.073221	0.087351	0.101482	0.115612	0.144195	0.172777	0.201359	0.230102
0.258845	0.287588	0.316331	0.345074	0.373817	0.421829	0.457797	0.493766
0.529735	0.565704	0.601673	0.637641	0.673771	0.709900	0.746029	0.782159
0.818288	0.854418	0.890547	0.926676	0.962806	0.998935	1.034986	1.071034
1.107083	1.143132	1.179181	1.215230	1.251279	1.287328	1.323377	1.359586
1.395795	1.445634						
-0.012408	-0.016409	-0.020285	-0.023827	-0.026850	-0.029293	-0.031439	-0.035134
-0.038392	-0.041472	-0.044263	-0.046990	-0.051852	-0.056150	-0.060130	-0.063882
-0.067517	-0.070904	-0.074169	-0.077313	-0.080284	-0.085030	-0.088443	-0.091734
-0.094884	-0.097949	-0.100959	-0.103889	-0.106745	-0.109517	-0.112206	-0.114817
-0.117360	-0.119834	-0.122244	-0.124587	-0.126850	-0.129029	-0.131175	-0.133317
-0.135342	-0.137270	-0.139133	-0.140947	-0.142727	-0.144473	-0.146158	-0.147764
-0.149253	-0.151095						
AJ-AJ	9.2000	1.627062	-0.005636	1.288412	83.51036		
0.016885	0.016776	0.001912	0.154287	1.472842	0.004562		
0.004430	0.009637	0.015006	0.020702	0.026722	0.033068	0.039740	0.053408
0.067402	0.081396	0.095553	0.109710	0.138349	0.167313	0.196440	0.225567
0.254857	0.284146	0.313599	0.343051	0.372504	0.421157	0.458095	0.495032
0.532133	0.569233	0.606333	0.643434	0.680534	0.717634	0.754735	0.791835
0.828935	0.866036	0.903136	0.940399	0.977662	1.014871	1.051997	1.089124
1.126250	1.163539	1.200828	1.238116	1.275405	1.312694	1.349982	1.387109
1.424235	1.476223						
0.013429	0.018446	0.023325	0.028115	0.032518	0.036264	0.039481	0.045221
0.050221	0.055142	0.059787	0.064032	0.072020	0.078826	0.085101	0.090843
0.096192	0.101220	0.105816	0.110169	0.114261	0.120282	0.124468	0.128358
0.131992	0.135332	0.138423	0.141352	0.144086	0.146573	0.148816	0.150841
0.152641	0.154260	0.155725	0.157026	0.158158	0.159120	0.159909	0.160523
0.161045	0.161511	0.161727	0.161728	0.161592	0.161337	0.160980	0.160511
0.159901	0.158811						
0.007079	0.013099	0.019283	0.025792	0.032463	0.039298	0.046294	0.060451
0.074771	0.089090	0.103409	0.117729	0.146693	0.175657	0.204784	0.233911
0.263038	0.292165	0.321292	0.350419	0.379546	0.428200	0.464649	0.501099
0.537548	0.573998	0.610447	0.646896	0.683346	0.719795	0.756245	0.792857
0.829469	0.866081	0.902693	0.939306	0.975918	1.012484	1.049124	1.085764
1.122404	1.159044	1.195684	1.232325	1.268965	1.305605	1.342245	1.378885
1.415525	1.465520						
-0.011910	-0.015719	-0.019329	-0.022727	-0.025578	-0.027876	-0.029858	-0.033309
-0.036267	-0.039041	-0.041566	-0.043998	-0.048558	-0.052574	-0.056335	-0.059855
-0.063237	-0.066458	-0.069489	-0.072475	-0.075330	-0.079880	-0.083165	-0.086353
-0.089455	-0.092464	-0.095411	-0.098316	-0.101166	-0.103951	-0.106675	-0.109352
-0.111969	-0.114536	-0.117058	-0.119527	-0.121937	-0.124291	-0.126597	-0.128852
-0.131081	-0.133287	-0.135411	-0.137476	-0.139499	-0.141481	-0.143419	-0.145309
-0.147142	-0.149552						

AK-AK	9.8200	1.638887	0.003455	1.386509	82.86084		
0.016173	0.016039	0.002081	0.153666	1.485265	0.003642		
0.004330	0.009575	0.015148	0.020884	0.026949	0.033341	0.039897	0.053665
0.067759	0.081850	0.096105	0.110360	0.139199	0.168364	0.197694	0.227188
0.256681	0.286175	0.315832	0.345490	0.375147	0.424139	0.461498	0.498856
0.536215	0.573573	0.610932	0.648290	0.685649	0.723171	0.760694	0.798216
0.835738	0.873261	0.910783	0.948306	0.985828	1.023403	1.060911	1.098419
1.135927	1.173435	1.210943	1.248451	1.285959	1.323467	1.360975	1.398483
1.435991	1.488659						
0.013239	0.018192	0.023193	0.027973	0.032403	0.036225	0.039464	0.045291
0.050221	0.055095	0.059775	0.064023	0.072077	0.079042	0.085375	0.091210
0.096606	0.101666	0.106268	0.110593	0.114718	0.120715	0.124881	0.128790
0.132394	0.135630	0.138621	0.141475	0.144138	0.146582	0.148803	0.150792
0.152538	0.154087	0.155450	0.156640	0.157698	0.158606	0.159308	0.159802
0.160195	0.160552	0.160727	0.160661	0.160426	0.160050	0.159572	0.159003
0.158345	0.157269						
0.007295	0.013523	0.019915	0.026471	0.033355	0.040239	0.047287	0.061710
0.076130	0.090549	0.105132	0.119715	0.148880	0.178210	0.207540	0.236870
0.266199	0.295529	0.324859	0.354188	0.383518	0.432510	0.469213	0.505916
0.542620	0.579323	0.616026	0.652729	0.689432	0.726135	0.762838	0.799541
0.836244	0.872948	0.909651	0.946354	0.983221	1.019993	1.056849	1.093704
1.130560	1.167416	1.204271	1.241127	1.277983	1.314838	1.351694	1.388550
1.425406	1.476328						
-0.011524	-0.015123	-0.018553	-0.021702	-0.024422	-0.026588	-0.028467	-0.031725
-0.034459	-0.037052	-0.039424	-0.041681	-0.045921	-0.049642	-0.053078	-0.056314
-0.059478	-0.062536	-0.065443	-0.068300	-0.071058	-0.075480	-0.078700	-0.081853
-0.084932	-0.087929	-0.090886	-0.093812	-0.096699	-0.099544	-0.102350	-0.105120
-0.107853	-0.110546	-0.113196	-0.115810	-0.118405	-0.120959	-0.123471	-0.125938
-0.128387	-0.130829	-0.133224	-0.135563	-0.137863	-0.140128	-0.142366	-0.144581
-0.146772	-0.149762						
AL-AL	10.0000	1.641710	0.006712	1.413812	82.66817		
0.016021	0.015877	0.002143	0.153736	1.488016	0.003603		
0.004264	0.009518	0.014936	0.020683	0.026758	0.033161	0.039728	0.053520
0.067639	0.081756	0.096037	0.110318	0.139209	0.168427	0.197811	0.227358
0.256905	0.286616	0.316328	0.346039	0.375915	0.424996	0.462422	0.499849
0.537275	0.574702	0.612128	0.649555	0.687145	0.724736	0.762326	0.799917
0.837508	0.875098	0.912689	0.950280	0.987870	1.025442	1.063005	1.100569
1.138132	1.175695	1.213259	1.250822	1.288385	1.325949	1.363512	1.401075
1.438639	1.492034						
0.013180	0.018130	0.022986	0.027798	0.032307	0.036222	0.039482	0.045255
0.050349	0.055155	0.059858	0.064156	0.072274	0.079253	0.085603	0.091518
0.096921	0.101994	0.106705	0.110991	0.115096	0.121230	0.125447	0.129335
0.132887	0.136162	0.139193	0.141969	0.144575	0.147007	0.149222	0.151193
0.152941	0.154489	0.155828	0.157008	0.158048	0.158922	0.159608	0.160120
0.160506	0.160772	0.160885	0.160858	0.160680	0.160295	0.159767	0.159132
0.158412	0.157287						
0.007330	0.013569	0.019972	0.026704	0.033600	0.040660	0.047720	0.062168
0.076613	0.091059	0.105668	0.120277	0.149496	0.178879	0.208263	0.237646
0.267029	0.296412	0.325795	0.355178	0.384561	0.433642	0.470412	0.507182
0.543952	0.580722	0.617491	0.654261	0.691031	0.727801	0.764571	0.801341
0.838111	0.874880	0.911650	0.948420	0.985190	1.022108	1.059015	1.095922
1.132830	1.169737	1.206644	1.243551	1.280458	1.317366	1.354273	1.391180
1.428087	1.478810						
-0.011407	-0.014931	-0.018290	-0.021466	-0.024161	-0.026329	-0.028133	-0.031364
-0.034036	-0.036553	-0.038889	-0.041069	-0.045248	-0.048874	-0.052243	-0.055449
-0.058521	-0.061545	-0.064444	-0.067230	-0.069974	-0.074334	-0.077489	-0.080604
-0.083670	-0.086696	-0.089685	-0.092636	-0.095553	-0.098435	-0.101278	-0.104079
-0.106843	-0.109569	-0.112259	-0.114919	-0.117551	-0.120159	-0.122728	-0.125263
-0.127775	-0.130263	-0.132717	-0.135139	-0.137526	-0.139872	-0.142192	-0.144490
-0.146765	-0.149856						

CA131200.N223548

TITLE

FLAP-INLET GUIDE VANE,REAR (I.D.) CAT 1 P/N4060682 NO REV EMD4060682 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830811	R.L.SANFORD	830811

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
311548			237442	1	4060682 NO REV	4060682 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

FLAP-INLET GUIDE VANE,REAR (I.D.) CAT 1 P/N4060682 NO REV EMD4060682 NO REV

8 22	3	0					
A-A	* 0.3180	1.004217	0.000000	0.125000	89.99988		
0.125000	0.125000	0.000000	0.024871	0.979346	0.000003		
0.062499	0.070921	0.079942	0.127406	0.174823	0.222232	0.269658	0.317088
0.364515	0.411944	0.459375	0.506808	0.554242	0.601674	0.649103	0.696529
0.743954	0.791379	0.838802	0.886225	0.933647	0.981068		
0.108253	0.111542	0.112172	0.107971	0.103265	0.098469	0.093855	0.089278
0.084680	0.080089	0.075524	0.070981	0.066440	0.061885	0.057301	0.052687
0.048058	0.043427	0.038784	0.034134	0.029478	0.024814		
0.062499	0.070922	0.079942	0.127407	0.174824	0.222233	0.269658	0.317088
0.364516	0.411944	0.459376	0.506809	0.554241	0.601674	0.649104	0.696530
0.743954	0.791379	0.838802	0.886226	0.933647	0.981068		
-0.108252	-0.111542	-0.112172	-0.107970	-0.103264	-0.098468	-0.093854	-0.089276
-0.084678	-0.080086	-0.075521	-0.070978	-0.066437	-0.061881	-0.057297	-0.052683
-0.048053	-0.043423	-0.038779	-0.034129	-0.029473	-0.024808		
B-B	0.4800	1.055739	-0.000001	0.125000	90.00026		
0.125000	0.125000	-0.000001	0.024982	1.030757	-0.000004		
0.066044	0.073998	0.082446	0.132492	0.182486	0.232462	0.282452	0.332450
0.382445	0.432441	0.482439	0.532441	0.582441	0.632441	0.682438	0.732432
0.782426	0.832419	0.882412	0.932404	0.982396	1.032387		
0.110223	0.113123	0.113685	0.109576	0.104874	0.099981	0.095237	0.090576
0.085879	0.081193	0.076535	0.071901	0.067271	0.062628	0.057957	0.053253
0.048549	0.043829	0.039109	0.034387	0.029657	0.024925		
0.066043	0.073997	0.082445	0.132491	0.182485	0.232461	0.282452	0.332450
0.382445	0.432440	0.482439	0.532439	0.582441	0.632440	0.682438	0.732432
0.782426	0.832419	0.882411	0.932404	0.982396	1.032387		
-0.110224	-0.113123	-0.113686	-0.109577	-0.104876	-0.099983	-0.095239	-0.090578
-0.085882	-0.081196	-0.076539	-0.071905	-0.067275	-0.062633	-0.057962	-0.053259
-0.048554	-0.043835	-0.039116	-0.034394	-0.029664	-0.024933		
C-C	0.6410	1.111037	-0.000000	0.125000	89.99985		
0.125000	0.125000	-0.000000	0.025008	1.086029	0.000003		

* For definition of this dimension — see drawing T4060682.

0.069576	0.077069	0.084966	0.137790	0.190558	0.243301	0.296053	0.348816
0.401577	0.454338	0.507102	0.559868	0.612635	0.665402	0.718166	0.770928
0.823689	0.876449	0.929210	0.981969	1.034729	1.087488		
0.112041	0.114583	0.115078	0.111050	0.106360	0.101377	0.096497	0.091737
0.086948	0.082165	0.077414	0.072690	0.067977	0.063256	0.058508	0.053729
0.048947	0.044154	0.039367	0.034569	0.029774	0.024968		
0.069577	0.077070	0.084967	0.137790	0.190559	0.243302	0.296054	0.348817
0.401578	0.454339	0.507102	0.559869	0.612636	0.665403	0.718167	0.770928
0.823689	0.876450	0.929210	0.981970	1.034729	1.087488		
-0.112042	-0.114584	-0.115079	-0.111050	-0.106360	-0.101377	-0.096496	-0.091736
-0.086947	-0.082163	-0.077411	-0.072688	-0.067974	-0.063253	-0.058504	-0.053725
-0.048943	-0.044150	-0.039362	-0.034564	-0.029768	-0.024962		
D-D	1.0200	1.244266	-0.000000	0.125000	90.00002		
0.125000	0.125000	-0.000000	0.024943	1.219322	0.000000		
0.076677	0.083226	0.090036	0.149618	0.209151	0.268636	0.328111	0.387601
0.447094	0.506586	0.566079	0.625576	0.685073	0.744573	0.804069	0.863564
0.923058	0.982553	1.042048	1.101542	1.161037	1.220532		
0.115282	0.117186	0.117562	0.113802	0.109355	0.104287	0.099107	0.094105
0.089137	0.084155	0.079191	0.074267	0.069360	0.064464	0.059543	0.054597
0.049643	0.044693	0.039751	0.034799	0.029861	0.024914		
0.076678	0.083226	0.090036	0.149617	0.209151	0.268636	0.328111	0.387601
0.447094	0.506585	0.566079	0.625575	0.685073	0.744572	0.804070	0.863565
0.923058	0.982552	1.042048	1.101542	1.161038	1.220532		
-0.115282	-0.117186	-0.117563	-0.113802	-0.109355	-0.104286	-0.099105	-0.094105
-0.089137	-0.084155	-0.079190	-0.074267	-0.069360	-0.064464	-0.059543	-0.054597
-0.049642	-0.044692	-0.039751	-0.034799	-0.029861	-0.024913		
E-E	1.3990	1.384783	0.000000	0.125000	89.99995		
0.125000	0.125000	0.000000	0.024887	1.359895	0.000002		
0.082075	0.087860	0.093825	0.160604	0.227347	0.294039	0.360698	0.427361
0.494038	0.560712	0.627386	0.694064	0.760743	0.827423	0.894104	0.960780
1.027457	1.094135	1.160813	1.227491	1.294169	1.360847		
0.117399	0.118881	0.119188	0.115674	0.111557	0.106667	0.101325	0.096072
0.090972	0.085835	0.080710	0.075625	0.070569	0.065514	0.060453	0.055365
0.050277	0.045195	0.040109	0.035025	0.029949	0.024871		
0.082075	0.087861	0.093825	0.160605	0.227348	0.294040	0.360698	0.427362
0.494038	0.560712	0.627386	0.694064	0.760744	0.827424	0.894104	0.960780
1.027456	1.094135	1.160813	1.227491	1.294169	1.360847		
-0.117399	-0.118881	-0.119188	-0.115675	-0.111557	-0.106665	-0.101324	-0.096071
-0.090971	-0.085834	-0.080709	-0.075624	-0.070567	-0.065512	-0.060451	-0.055362
-0.050275	-0.045192	-0.040106	-0.035022	-0.029946	-0.024867		
F-F	1.7770	1.532888	-0.000000	0.125000	90.00012		
0.125000	0.125000	-0.000000	0.024878	1.508010	-0.000003		
0.090433	0.095092	0.099843	0.174100	0.248326	0.322510	0.396643	0.470764
0.544900	0.619038	0.693174	0.767314	0.841454	0.915597	0.989740	1.063881
1.138023	1.212164	1.286306	1.360449	1.434592	1.508736		
0.120125	0.121074	0.121274	0.118041	0.114160	0.109550	0.104167	0.098630
0.093288	0.087974	0.082649	0.077354	0.072096	0.066850	0.061606	0.056348
0.051084	0.045831	0.040576	0.035332	0.030100	0.024865		
0.090432	0.095092	0.099842	0.174099	0.248325	0.322510	0.396642	0.470764
0.544899	0.619038	0.693174	0.767313	0.841454	0.915597	0.989739	1.063880
1.138021	1.212163	1.286305	1.360449	1.434592	1.508736		
-0.120126	-0.121074	-0.121275	-0.118042	-0.114161	-0.109551	-0.104169	-0.098632
-0.093291	-0.087977	-0.082651	-0.077357	-0.072099	-0.066853	-0.061610	-0.056352
-0.051088	-0.045835	-0.040580	-0.035337	-0.030105	-0.024870		
G-G	2.1560	1.690806	-0.000000	0.125000	90.00002		
0.125000	0.125000	-0.000000	0.024918	1.665888	0.000000		
0.096946	0.100679	0.104459	0.186784	0.269075	0.351333	0.433540	0.515714
0.597894	0.680084	0.762272	0.844460	0.926653	1.008845	1.091039	1.173231
1.255424	1.337616	1.419810	1.502003	1.584197	1.666391		
0.121811	0.122426	0.122566	0.119841	0.116220	0.111910	0.106726	0.101027

0.095426	0.089969	0.084478	0.079007	0.073582	0.068170	0.062766	0.057350
0.051924	0.046509	0.041099	0.035700	0.030306	0.024913		
0.096947	0.100679	0.104459	0.186784	0.269076	0.351333	0.433540	0.515714
0.597894	0.680084	0.762272	0.844460	0.926653	1.008845	1.091039	1.173232
1.255424	1.337616	1.419809	1.502003	1.584197	1.666390		
-0.121811	-0.122426	-0.122567	-0.119841	-0.116220	-0.111910	-0.106726	-0.101027
-0.095426	-0.089968	-0.084478	-0.079007	-0.073582	-0.068170	-0.062765	-0.057349
-0.051923	-0.046509	-0.041098	-0.035699	-0.030306	-0.024912		
H-H	2.3380	1.768634	-0.000000	0.125000	90.00012		
0.125000	0.125000	-0.000000	0.025012	1.743621	-0.000003		
0.101779	0.104860	0.107968	0.194206	0.280408	0.366579	0.452702	0.538784
0.624865	0.710958	0.797050	0.883142	0.969238	1.055333	1.141430	1.227526
1.313622	1.399717	1.485813	1.571910	1.658008	1.744105		
0.122824	0.123242	0.123340	0.120919	0.117457	0.113286	0.108243	0.102504
0.096762	0.091209	0.085632	0.080061	0.074538	0.069027	0.063521	0.058008
0.052492	0.046980	0.041477	0.035980	0.030487	0.025005		
0.101779	0.104860	0.107968	0.194206	0.280408	0.366579	0.452702	0.538784
0.624865	0.710958	0.797050	0.883142	0.969238	1.055333	1.141430	1.227525
1.313622	1.399716	1.485813	1.571911	1.658008	1.744105		
-0.122824	-0.123243	-0.123340	-0.120920	-0.117458	-0.113287	-0.108244	-0.102506
-0.096764	-0.091212	-0.085634	-0.080064	-0.074541	-0.069031	-0.063525	-0.058012
-0.052496	-0.046985	-0.041482	-0.035985	-0.030492	-0.025011		

CA131300.N223545

TITLE

FLAP-INLET GUIDE VANE,REAR (O.D.) CAT 1 P/N4060681 NO REV EMD4060681 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830811	R.L.SANFORD	830811

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
31154B			237442	1	4060681 NO REV	4060681 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

FLAP-INLET GUIDE VANE,REAR (O.D.) CAT 1 P/N4060681 NO REV EMD4060681 NO REV

11	27	3	0				
A-A	* 5.8980	1.760537	-0.001203	0.155995	89.45580		
0.156000	0.155995	-0.001203	0.031246	1.729291	0.000113		
0.137757	0.141113	0.144480	0.210769	0.277029	0.343258	0.409456	0.475604
0.541704	0.607791	0.673888	0.739989	0.806082	0.872172	0.938262	1.004351
1.070435	1.136514	1.202589	1.268657	1.334721	1.400779	1.466833	1.532882
1.598927	1.664968	1.731005					
0.153727	0.154008	0.154062	0.152376	0.149765	0.146453	0.142559	0.137907
0.132608	0.127155	0.121818	0.116532	0.111151	0.105736	0.100308	0.094868
0.089384	0.083841	0.078245	0.072563	0.066817	0.061020	0.055182	0.049290
0.043343	0.037351	0.031312					
0.135370	0.139562	0.143771	0.210053	0.276290	0.342492	0.408661	0.474776
0.540845	0.606905	0.672985	0.739079	0.805174	0.871273	0.937380	1.003492
1.069612	1.135734	1.201859	1.267986	1.334119	1.400255	1.466393	1.532537
1.598684	1.664835	1.730989					
-0.155834	-0.156214	-0.156240	-0.153395	-0.149670	-0.145334	-0.140535	-0.135041
-0.129010	-0.122884	-0.116987	-0.111240	-0.105495	-0.099814	-0.094215	-0.088693
-0.083238	-0.077833	-0.072463	-0.067120	-0.061828	-0.056583	-0.051379	-0.046239
-0.041132	-0.036081	-0.031086					
B-B	5.4700	1.899254	0.001311	0.155994	88.56271		
0.156000	0.155994	0.001311	0.031170	1.868085	0.000223		
0.134311	0.137999	0.141705	0.213889	0.286048	0.358177	0.430279	0.502337
0.574343	0.646326	0.718315	0.790310	0.862296	0.934278	1.006256	1.078234
1.150208	1.222174	1.294136	1.366088	1.438034	1.509975	1.581911	1.653841
1.725766	1.797685	1.869597					
0.155797	0.156176	0.156280	0.155068	0.152788	0.149694	0.146021	0.141568
0.136358	0.130818	0.125369	0.119989	0.114499	0.108949	0.103363	0.097753
0.092086	0.086359	0.080552	0.074635	0.068643	0.062593	0.056471	0.050291
0.044046	0.037728	0.031355					
0.136912	0.140712	0.144527	0.216532	0.288496	0.360424	0.432322	0.504176
0.575980	0.647768	0.719574	0.791397	0.863222	0.935054	1.006891	1.078737

* For definition of this dimension — see drawing T4060681.

1.150589	1.222445	1.294309	1.366174	1.438045	1.509921	1.581801	1.653687
1.725576	1.797470	1.869370					
-0.153517	-0.153839	-0.153870	-0.151195	-0.147588	-0.143309	-0.138567	-0.133190
-0.127183	-0.120988	-0.114996	-0.109228	-0.103476	-0.097805	-0.092220	-0.086729
-0.081330	-0.075995	-0.070726	-0.065513	-0.060362	-0.055288	-0.050272	-0.045328
-0.040456	-0.035651	-0.030921					
C-C	4.8440	2.111616	0.001856	0.155989	87.19080		
0.156000	0.155989	0.001856	0.031154	2.080463	0.000354		
0.138631	0.141304	0.143984	0.224912	0.305825	0.386713	0.467574	0.548403
0.629181	0.709925	0.790663	0.871411	0.952151	1.032881	1.113608	1.194331
1.275049	1.355761	1.436464	1.517158	1.597840	1.678517	1.759189	1.839852
1.920508	2.001157	2.081799					
0.156887	0.157114	0.157197	0.156858	0.155291	0.152716	0.149416	0.145375
0.140465	0.134982	0.129452	0.124021	0.118480	0.112830	0.107120	0.101352
0.095509	0.089575	0.083539	0.077365	0.071066	0.064688	0.058229	0.051671
0.045037	0.038305	0.031480					
0.142324	0.145142	0.147964	0.228648	0.309294	0.389901	0.470477	0.551022
0.631518	0.711984	0.792462	0.872962	0.953471	1.033984	1.114506	1.195035
1.275574	1.356120	1.436672	1.517230	1.597798	1.678369	1.758945	1.839530
1.920121	2.000715	2.081317					
-0.153545	-0.153712	-0.153721	-0.151191	-0.147661	-0.143317	-0.138452	-0.133081
-0.127017	-0.120580	-0.114285	-0.108281	-0.102383	-0.096562	-0.090859	-0.085279
-0.079805	-0.074447	-0.069182	-0.064037	-0.058990	-0.054046	-0.049190	-0.044443
-0.039790	-0.035237	-0.030788					
D-D	4.2280	2.329100	0.001835	0.155989	85.79541		
0.156000	0.155989	0.001835	0.031184	2.297918	0.000463		
0.146045	0.147299	0.148555	0.238336	0.328118	0.417881	0.507622	0.597336
0.687007	0.776634	0.866248	0.955864	1.045477	1.135078	1.224672	1.314260
1.403843	1.493417	1.582982	1.672533	1.762072	1.851604	1.941125	2.030639
2.120144	2.209638	2.299124					
0.157518	0.157582	0.157615	0.158288	0.157584	0.155674	0.152839	0.149284
0.144773	0.139467	0.133913	0.128432	0.122881	0.117149	0.111313	0.105391
0.099357	0.093210	0.086933	0.080463	0.073814	0.067078	0.060214	0.053240
0.046156	0.038946	0.031624					
0.149710	0.151312	0.152913	0.242426	0.331905	0.421344	0.510751	0.600131
0.689469	0.778771	0.868075	0.957403	1.046745	1.136094	1.225451	1.314822
1.404201	1.493587	1.582983	1.672389	1.761803	1.851224	1.940653	2.030087
2.119530	2.208978	2.298431					
-0.154038	-0.154077	-0.154065	-0.151536	-0.147988	-0.143550	-0.138484	-0.132983
-0.126838	-0.120179	-0.113551	-0.107255	-0.101164	-0.095181	-0.089339	-0.083657
-0.078124	-0.072729	-0.067476	-0.062404	-0.057489	-0.052697	-0.048037	-0.043510
-0.039114	-0.034851	-0.030716					
E-E	3.6020	2.560472	0.003539	0.155960	84.44019		
0.156137	0.156097	0.003547	0.031206	2.529272	0.000616		
0.152298	0.156141	0.161367	0.251545	0.350806	0.450060	0.549295	0.648507
0.747685	0.846814	0.945919	1.045022	1.144123	1.243209	1.342288	1.441358
1.540420	1.639472	1.738512	1.837537	1.936543	2.035541	2.134527	2.233502
2.332466	2.431417	2.530357					
0.159638	0.159727	0.159842	0.161289	0.161545	0.160378	0.158064	0.154940
0.150843	0.145750	0.140156	0.134551	0.128905	0.123026	0.116992	0.110826
0.104534	0.098076	0.091449	0.084579	0.077476	0.070234	0.062847	0.055312
0.047628	0.039788	0.031803					
0.159381	0.164277	0.169299	0.258233	0.357055	0.455838	0.554587	0.653313
0.752005	0.850658	0.949304	1.047971	1.146661	1.245358	1.344069	1.442790
1.541521	1.640264	1.739016	1.837780	1.936556	2.035339	2.134130	2.232928
2.331735	2.430547	2.529365					
-0.152555	-0.152446	-0.152331	-0.149947	-0.146410	-0.141915	-0.136696	-0.131064
-0.124872	-0.118082	-0.111182	-0.104614	-0.098385	-0.092296	-0.086389	-0.080674
-0.075152	-0.069814	-0.064663	-0.059760	-0.055095	-0.050582	-0.046235	-0.042061
-0.038066	-0.034241	-0.030590					

F-F	2.9760	2.800242	0.006404	0.155868	83.10599		
0.156000	0.155868	0.006404	0.031095	2.769157	0.000780		
0.140280	0.141927	0.143579	0.253160	0.362772	0.472395	0.582008	0.691598
0.801164	0.910686	1.020166	1.129637	1.239105	1.348560	1.458002	1.567432
1.676854	1.786262	1.895655	2.005030	2.114383	2.223722	2.333049	2.442359
2.551658	2.660938	2.770205					
0.161623	0.161761	0.161844	0.164847	0.166358	0.166266	0.164721	0.162078
0.158526	0.153806	0.148221	0.142429	0.136613	0.130536	0.124232	0.117739
0.111077	0.104211	0.097117	0.089738	0.082036	0.074144	0.066075	0.057808
0.049357	0.040701	0.031857					
0.153065	0.154017	0.154968	0.263970	0.372949	0.481893	0.590799	0.699679
0.808537	0.917358	1.026158	1.134974	1.243819	1.352677	1.461550	1.570434
1.679331	1.788239	1.897161	2.006095	2.115043	2.223998	2.332962	2.441936
2.550914	2.659900	2.768893					
-0.149571	-0.149579	-0.149569	-0.146941	-0.143463	-0.139015	-0.133725	-0.127923
-0.121713	-0.114892	-0.107742	-0.100857	-0.094433	-0.088241	-0.082280	-0.076564
-0.071084	-0.065847	-0.060851	-0.056165	-0.051820	-0.047685	-0.043759	-0.040064
-0.036591	-0.033335	-0.030314					
G-G	2.3500	3.047098	0.005760	0.155894	81.69252		
0.156000	0.155894	0.005760	0.031026	3.016085	0.000909		
0.125679	0.129536	0.133430	0.253677	0.373972	0.494296	0.614627	0.734945
0.855243	0.975508	1.095726	1.215921	1.336112	1.456292	1.576454	1.696602
1.816739	1.936859	2.056962	2.177046	2.297097	2.417133	2.537152	2.657155
2.777138	2.897102	3.017049					
0.158806	0.159412	0.159715	0.164214	0.167222	0.168523	0.168114	0.166302
0.163451	0.159416	0.154194	0.148453	0.142635	0.136571	0.130176	0.123524
0.116655	0.109514	0.102107	0.094356	0.086157	0.077709	0.069042	0.060126
0.050970	0.041563	0.031920					
0.137056	0.140698	0.144353	0.264058	0.383743	0.503398	0.623015	0.742602
0.862170	0.981711	1.101223	1.220741	1.340291	1.459864	1.579451	1.699051
1.818666	1.938295	2.057937	2.177594	2.297268	2.416950	2.536641	2.656339
2.776045	2.895758	3.015475					
-0.149098	-0.149407	-0.149448	-0.146421	-0.142706	-0.138122	-0.132641	-0.126514
-0.120053	-0.113090	-0.105652	-0.098333	-0.091542	-0.085133	-0.079016	-0.073189
-0.067662	-0.062434	-0.057515	-0.052962	-0.048872	-0.045073	-0.041523	-0.038254
-0.035264	-0.032549	-0.030111					
H-H	1.7340	3.298000	0.006158	0.155878	80.34502		
0.156000	0.155878	0.006158	0.030990	3.267028	0.001059		
0.120575	0.124933	0.129344	0.260187	0.391074	0.522011	0.652974	0.783937
0.914885	1.045806	1.176682	1.307526	1.438361	1.569184	1.699987	1.830772
1.961544	2.092298	2.223029	2.353737	2.484409	2.615058	2.745686	2.876294
3.006879	3.137439	3.267976					
0.158111	0.158922	0.159343	0.165033	0.169561	0.172269	0.173082	0.172131
0.169920	0.166517	0.161713	0.156037	0.150154	0.144041	0.137493	0.130620
0.123453	0.115979	0.108158	0.099935	0.091159	0.082026	0.072636	0.062943
0.052948	0.042646	0.032035					
0.132673	0.137019	0.141388	0.271637	0.401877	0.532090	0.662268	0.792412
0.922537	1.052643	1.182721	1.312796	1.442904	1.573035	1.703188	1.833357
1.963542	2.093742	2.223956	2.354187	2.484433	2.614694	2.744961	2.875233
3.005515	3.135800	3.266092					
-0.148106	-0.148567	-0.148646	-0.144955	-0.140889	-0.136065	-0.130375	-0.123958
-0.117166	-0.110024	-0.102373	-0.094685	-0.087534	-0.080919	-0.074661	-0.068783
-0.063255	-0.058084	-0.053299	-0.048949	-0.045190	-0.041823	-0.038750	-0.036027
-0.033651	-0.031618	-0.029917					
J-J	1.1080	3.561573	0.007008	0.155842	78.96831		
0.156000	0.155842	0.007008	0.031002	3.530594	0.001209		
0.111035	0.116495	0.122068	0.264121	0.406256	0.548458	0.690709	0.832975
0.975235	1.117476	1.259678	1.401838	1.543981	1.686113	1.828222	1.970310
2.112379	2.254428	2.396452	2.538449	2.680401	2.822323	2.964223	3.106095
3.247941	3.389757	3.531545					

0.156434	0.157742	0.158430	0.166174	0.172300	0.176576	0.178781	0.178932
0.177465	0.174735	0.170481	0.164960	0.158987	0.152779	0.146055	0.138893
0.131368	0.123471	0.115155	0.106375	0.096917	0.086982	0.076752	0.066157
0.055199	0.043883	0.032197					
0.124627	0.130250	0.135929	0.277357	0.418774	0.560170	0.701536	0.842870
0.984182	1.125483	1.266758	1.408027	1.549321	1.690651	1.832002	1.973373
2.114761	2.256165	2.397584	2.539020	2.680471	2.821937	2.963408	3.104886
3.246368	3.387855	3.529346					
-0.145837	-0.146656	-0.146832	-0.142584	-0.137949	-0.132723	-0.126742	-0.120030
-0.112887	-0.105526	-0.097728	-0.089753	-0.082261	-0.075466	-0.069150	-0.063286
-0.057842	-0.052829	-0.048276	-0.044225	-0.040895	-0.038077	-0.035607	-0.033542
-0.031879	-0.030618	-0.029767					
K-K	0.7880	3.699001	0.008483	0.155769	78.29906		
0.156000	0.155769	0.008483	0.031098	3.667931	0.001303		
0.105805	0.111969	0.118293	0.266172	0.414179	0.562254	0.710383	0.858540
1.006697	1.154838	1.302943	1.451006	1.599044	1.747071	1.895076	2.043057
2.191017	2.338957	2.486869	2.634753	2.782588	2.930386	3.078156	3.225890
3.373593	3.521267	3.668908					
0.156265	0.157919	0.158775	0.167835	0.174602	0.179658	0.182612	0.183380
0.182306	0.179893	0.175922	0.170509	0.164480	0.158203	0.151385	0.144073
0.136365	0.128253	0.119678	0.110620	0.100804	0.090423	0.079677	0.068444
0.056804	0.044790	0.032385					
0.122150	0.128187	0.134296	0.281500	0.428688	0.575861	0.723007	0.870121
1.017211	1.164293	1.311356	1.458406	1.605479	1.752588	1.899725	2.046880
2.194054	2.341243	2.488448	2.635668	2.782907	2.930159	3.077415	3.224680
3.371948	3.519218	3.666491					
-0.143851	-0.144801	-0.145007	-0.140571	-0.135585	-0.130170	-0.124066	-0.117247
-0.109947	-0.102472	-0.094621	-0.086533	-0.078881	-0.071982	-0.065636	-0.059766
-0.054360	-0.049411	-0.044969	-0.041057	-0.037937	-0.035429	-0.033348	-0.031797
-0.030705	-0.030037	-0.029761					
L-L	0.3000	3.909704	0.008562	0.155765	77.31290		
0.156000	0.155765	0.008562	0.031354	3.878385	0.001484		
0.102726	0.109240	0.115947	0.272614	0.429464	0.586384	0.743379	0.900417
1.057465	1.214499	1.371507	1.528467	1.685397	1.842313	1.999206	2.156070
2.312912	2.469730	2.626521	2.783278	2.939985	3.096647	3.253284	3.409885
3.566457	3.722995	3.879496					
0.155269	0.157136	0.158105	0.169040	0.176892	0.183232	0.187280	0.189000
0.188552	0.186568	0.183009	0.177753	0.171626	0.165155	0.158152	0.150539
0.142483	0.133992	0.124982	0.115415	0.105064	0.094041	0.082675	0.070832
0.058601	0.045938	0.032819					
0.119126	0.125696	0.132356	0.288391	0.444404	0.600409	0.756391	0.912344
1.068274	1.224195	1.380102	1.535995	1.691906	1.847857	2.003835	2.159834
2.315852	2.471887	2.627935	2.784000	2.940082	3.096175	3.252274	3.408378
3.564484	3.720592	3.876700					
-0.143074	-0.144204	-0.144450	-0.139648	-0.134191	-0.128499	-0.122230	-0.115265
-0.107800	-0.100157	-0.092242	-0.084057	-0.076187	-0.069170	-0.062790	-0.056931
-0.051632	-0.046815	-0.042526	-0.038836	-0.035966	-0.033831	-0.032051	-0.030752
-0.029986	-0.029731	-0.029824					

CA135200.N2353FC

TITLE

BLADE & DISK (ID) CATEGORY 1 P/N4060023 NO REV EMD4060023 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
W.THOMAS	R.L.WALLS	830823	R.L.SANFORD	830823

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
311548			237441	1	4060023 NO REV	4060023 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

BLADE & DISK (ID) CATEGORY 1 P/N4060023 NO REV EMD4060023 NO REV

11	50	1	1				
AA-AA	* 3.4500	2.954144	1.048111	1.078865	113.28210		
0.014551	0.003295	0.014173	0.004120	2.953551	0.004077		
-0.010698	0.049865	0.110427	0.170990	0.231553	0.292115	0.352678	0.413241
0.473803	0.534366	0.594929	0.655491	0.716054	0.776617	0.837179	0.897742
0.958305	1.018867	1.079429	1.139991	1.200553	1.261115	1.321677	1.382239
1.442801	1.503364	1.563926	1.624488	1.685050	1.745612	1.806174	1.866736
1.927299	1.987861	2.048423	2.108985	2.169547	2.230109	2.290671	2.351233
2.411796	2.472358	2.532920	2.593482	2.654044	2.714606	2.775168	2.835731
2.896293	2.956874						
0.018163	0.240534	0.429979	0.577016	0.700849	0.809949	0.906532	0.992664
1.071758	1.143938	1.206162	1.263155	1.316714	1.365060	1.406407	1.439167
1.465046	1.485087	1.499480	1.508414	1.511979	1.509609	1.501736	1.489044
1.472221	1.451572	1.425602	1.394805	1.360061	1.322249	1.281701	1.236957
1.188463	1.136909	1.082984	1.026807	0.967339	0.905000	0.840311	0.773793
0.705379	0.634358	0.561178	0.486324	0.410283	0.332583	0.252592	0.171247
0.089495	0.006511						
0.016673	0.076543	0.136413	0.196283	0.256153	0.316023	0.375894	0.435764
0.495634	0.555504	0.615374	0.675244	0.735114	0.794984	0.854855	0.914725
0.974595	1.034465	1.094335	1.154204	1.214074	1.273944	1.333814	1.393683
1.453553	1.513423	1.573293	1.633162	1.693032	1.752902	1.812772	1.872642
1.932511	1.992381	2.052251	2.112121	2.171990	2.231860	2.291730	2.351600
2.411469	2.471339	2.531209	2.591079	2.650949	2.710818	2.770688	2.830558
2.890428	2.950312						
0.008452	0.151404	0.276732	0.386308	0.486882	0.578969	0.662618	0.739341
0.810744	0.876961	0.936212	0.991923	1.045164	1.094487	1.138444	1.175785
1.208414	1.236693	1.259975	1.277608	1.289002	1.294438	1.294533	1.289845
1.280931	1.268040	1.249931	1.227089	1.200318	1.170425	1.137712	1.100823
1.060184	1.016436	0.970220	0.921612	0.869572	0.814568	0.757171	0.697953
0.636875	0.573189	0.507320	0.439729	0.370878	0.300284	0.227317	0.152900
0.077967	0.001533						

* This dimension is the radial distance from the rig centerline to the airfoil manufacturing cross section. For further definition, see drawing T4060023.

BB-BB	3.6520	2.834683	0.986950	1.149034	107.62515		
0.013589	0.004922	0.012666	0.004454	2.833973	0.004397		
-0.007805	0.050268	0.108340	0.166412	0.224485	0.282557	0.340630	0.398702
0.456774	0.514847	0.572919	0.630992	0.689064	0.747136	0.805209	0.863281
0.921354	0.979426	1.037498	1.095570	1.153642	1.211714	1.269786	1.327858
1.385930	1.444002	1.502074	1.560146	1.618218	1.676291	1.734363	1.792435
1.850507	1.908579	1.966651	2.024723	2.082795	2.140867	2.198939	2.257011
2.315084	2.373156	2.431228	2.489300	2.547372	2.605444	2.663516	2.721588
2.779660	2.837746						
0.017429	0.177096	0.321594	0.443619	0.552202	0.650300	0.738537	0.818738
0.893157	0.961875	1.023285	1.080720	1.135416	1.186283	1.232226	1.272320
1.308243	1.340206	1.367539	1.389572	1.405766	1.416895	1.423260	1.424912
1.421905	1.414157	1.401098	1.383058	1.360516	1.333949	1.303362	1.267395
1.226583	1.181684	1.133451	1.081900	1.025604	0.965141	0.901220	0.834554
0.764949	0.691274	0.614225	0.534556	0.453021	0.368839	0.280964	0.190843
0.099947	0.006762						
0.016863	0.074280	0.131697	0.189114	0.246531	0.303948	0.361365	0.418782
0.476199	0.533616	0.591033	0.648450	0.705867	0.763284	0.820701	0.878118
0.935535	0.992952	1.050368	1.107785	1.165202	1.222619	1.280036	1.337453
1.394870	1.452287	1.509704	1.567121	1.624537	1.681954	1.739371	1.796788
1.854205	1.911622	1.969039	2.026456	2.083873	2.141290	2.198707	2.256124
2.313540	2.370957	2.428374	2.485791	2.543208	2.600625	2.658042	2.715459
2.772876	2.830298						
0.006180	0.113168	0.212361	0.302666	0.387319	0.466147	0.538917	0.606689
0.670549	0.730541	0.785136	0.836478	0.885612	0.931973	0.974993	1.014235
1.051039	1.085181	1.115705	1.141656	1.162292	1.178808	1.191339	1.199586
1.203253	1.202037	1.195860	1.185059	1.169994	1.151037	1.128182	1.100387
1.068078	1.031854	0.992312	0.949399	0.901864	0.850272	0.795309	0.737660
0.677150	0.612691	0.544931	0.474574	0.402320	0.327387	0.248756	0.167845
0.086089	0.001882						
CC-CC	3.9050	2.730427	0.894107	1.249377	99.77614		
0.013447	0.006344	0.011856	0.005039	2.729543	0.004961		
-0.005673	0.050239	0.106152	0.162064	0.217976	0.273889	0.329801	0.385713
0.441626	0.497538	0.553450	0.609363	0.665275	0.721187	0.777099	0.833012
0.888924	0.944836	1.000749	1.056661	1.112573	1.168485	1.224397	1.280309
1.336221	1.392133	1.448045	1.503957	1.559869	1.615781	1.671693	1.727605
1.783517	1.839429	1.895341	1.951253	2.007165	2.063077	2.118989	2.174901
2.230813	2.286725	2.342637	2.398549	2.454461	2.510373	2.566285	2.622197
2.678109	2.734032						
0.017880	0.131844	0.237208	0.329674	0.414106	0.492311	0.564387	0.631550
0.695645	0.756454	0.812072	0.864389	0.914531	0.962070	1.006578	1.047712
1.086339	1.122417	1.155450	1.184936	1.210546	1.233322	1.253070	1.269208
1.281152	1.288536	1.292165	1.291903	1.287412	1.278349	1.264376	1.245341
1.221371	1.192601	1.159168	1.120671	1.075908	1.025372	0.969661	0.909377
0.843850	0.771347	0.692911	0.609669	0.522750	0.430336	0.330338	0.225629
0.119126	0.007231						
0.017473	0.072732	0.127991	0.183250	0.238510	0.293769	0.349028	0.404287
0.459546	0.514805	0.570065	0.625324	0.680583	0.735842	0.791101	0.846360
0.901620	0.956879	1.012137	1.067396	1.122655	1.177914	1.233172	1.288431
1.343690	1.398949	1.454207	1.509466	1.564725	1.619984	1.675242	1.730501
1.785760	1.841019	1.896277	1.951536	2.006795	2.062054	2.117312	2.172571
2.227830	2.283089	2.338347	2.393606	2.448865	2.504124	2.559382	2.614641
2.669900	2.725175						
0.004319	0.086879	0.162901	0.232229	0.297368	0.358656	0.415830	0.469835
0.521996	0.572086	0.618611	0.662861	0.705596	0.746442	0.785026	0.821029
0.854979	0.886918	0.916597	0.943769	0.968321	0.991102	1.011738	1.029521
1.043743	1.053969	1.061193	1.065192	1.065484	1.061588	1.053142	1.040358
1.023276	1.001896	0.976215	0.945900	0.910175	0.869375	0.823901	0.774156
0.719518	0.658593	0.592296	0.521611	0.447520	0.368386	0.282340	0.191948
0.099809	0.002466						

DD-DD	4.1580	2.672489	0.789514	1.350164	90.98886		
0.012956	0.007499	0.010565	0.005938	2.671356	0.005830		
-0.003355	0.051343	0.106042	0.160740	0.215438	0.270137	0.324835	0.379534
0.434232	0.488930	0.543629	0.598327	0.653025	0.707724	0.762422	0.817120
0.871819	0.926517	0.981215	1.035913	1.090611	1.145309	1.200007	1.254705
1.309403	1.364101	1.418799	1.473497	1.528195	1.582893	1.637591	1.692289
1.746987	1.801685	1.856383	1.911081	1.965779	2.020477	2.075175	2.129873
2.184571	2.239269	2.293967	2.348665	2.403363	2.458061	2.512759	2.567457
2.622155	2.676866						
0.017638	0.102646	0.183737	0.258626	0.329621	0.395815	0.456711	0.513456
0.567107	0.617612	0.663871	0.707323	0.748873	0.788378	0.825693	0.860686
0.893456	0.924166	0.952939	0.979900	1.005236	1.029411	1.052016	1.072453
1.090129	1.104711	1.117168	1.127172	1.134131	1.137454	1.136925	1.133451
1.126493	1.115340	1.099283	1.077902	1.051461	1.019582	0.981835	0.937793
0.886288	0.825936	0.757294	0.680974	0.597586	0.502770	0.392706	0.272621
0.147809	0.008036						
0.017361	0.071415	0.125469	0.179522	0.233576	0.287630	0.341684	0.395738
0.449792	0.503846	0.557900	0.611954	0.666008	0.720061	0.774115	0.828169
0.882223	0.936277	0.990331	1.044384	1.098437	1.152491	1.206544	1.260597
1.314651	1.368704	1.422757	1.476810	1.530864	1.584917	1.638970	1.693024
1.747077	1.801130	1.855184	1.909237	1.963290	2.017344	2.071397	2.125450
2.179503	2.233557	2.287610	2.341663	2.395717	2.449770	2.503823	2.557877
2.611930	2.666005						
0.002165	0.066058	0.127063	0.184626	0.239993	0.292101	0.340445	0.385829
0.428953	0.469759	0.507296	0.542634	0.576475	0.608702	0.639199	0.667849
0.694632	0.719719	0.743300	0.765566	0.786733	0.807029	0.826149	0.843693
0.859265	0.872684	0.884766	0.895090	0.903003	0.907854	0.909395	0.908603
0.904947	0.897714	0.886192	0.870062	0.849846	0.825110	0.795350	0.760063
0.718355	0.669425	0.613681	0.551561	0.483504	0.406155	0.316630	0.218989
0.117347	0.003261						
EE-EE	4.4100	2.690388	0.662329	1.457625	82.27429		
0.012897	0.008985	0.009252	0.007505	2.688635	0.007297		
-0.000570	0.054456	0.109483	0.164509	0.219535	0.274562	0.329588	0.384615
0.439641	0.494667	0.549694	0.604720	0.659747	0.714773	0.769799	0.824826
0.879852	0.934879	0.989905	1.044931	1.099957	1.154984	1.210010	1.265036
1.320062	1.375088	1.430114	1.485140	1.540166	1.595192	1.650218	1.705244
1.760270	1.815296	1.870322	1.925348	1.980374	2.035400	2.090426	2.145452
2.200479	2.255505	2.310531	2.365557	2.420583	2.475609	2.530635	2.585661
2.640687	2.695725						
0.017913	0.079175	0.138239	0.193998	0.247646	0.298931	0.347712	0.394236
0.438751	0.481285	0.520984	0.558928	0.595651	0.630842	0.664190	0.695415
0.724803	0.752466	0.778356	0.802426	0.824650	0.845157	0.863951	0.880994
0.896246	0.909724	0.921653	0.931888	0.940221	0.946445	0.950653	0.953583
0.954510	0.952558	0.946851	0.937309	0.925166	0.909289	0.888394	0.861196
0.827158	0.786618	0.738489	0.681638	0.614932	0.531885	0.427543	0.307316
0.176693	0.009753						
0.017400	0.071775	0.126150	0.180525	0.234901	0.289276	0.343651	0.398026
0.452401	0.506777	0.561152	0.615527	0.669902	0.724277	0.778652	0.833028
0.887403	0.941778	0.996153	1.050528	1.104902	1.159277	1.213652	1.268026
1.322401	1.376776	1.431150	1.485525	1.539900	1.594275	1.648649	1.703024
1.757399	1.811773	1.866148	1.920523	1.974897	2.029272	2.083647	2.138021
2.192396	2.246771	2.301146	2.355520	2.409895	2.464270	2.518644	2.573019
2.627394	2.681785						
-0.000520	0.046565	0.091926	0.135076	0.176717	0.216673	0.254832	0.291344
0.326365	0.359906	0.391278	0.421331	0.450454	0.478356	0.504747	0.529367
0.552473	0.574146	0.594318	0.612920	0.629878	0.645141	0.658856	0.671200
0.682350	0.692470	0.701536	0.709424	0.716015	0.721188	0.725106	0.728459
0.730466	0.730198	0.726725	0.719910	0.711019	0.699063	0.682904	0.661403
0.634200	0.601875	0.563561	0.518339	0.465292	0.400078	0.319660	0.227852
0.128516	0.004232						

FF-FF	4.6630	2.768660	0.520536	1.549423	74.19197		
0.012961	0.010265	0.007912	0.010060	2.765314	0.009488		
0.002008	0.058594	0.115180	0.171766	0.228352	0.284939	0.341525	0.398111
0.454697	0.511284	0.567870	0.624456	0.681042	0.737628	0.794215	0.850801
0.907387	0.963973	1.020559	1.077145	1.133730	1.190315	1.246901	1.303486
1.360071	1.416656	1.473242	1.529827	1.586412	1.642998	1.699583	1.756168
1.812754	1.869339	1.925924	1.982510	2.039095	2.095680	2.152266	2.208851
2.265436	2.322021	2.378607	2.435192	2.491777	2.548363	2.604948	2.661533
2.718119	2.774734						
0.017901	0.065065	0.110522	0.153898	0.196064	0.236529	0.275110	0.311993
0.347308	0.381077	0.412564	0.442573	0.471556	0.499318	0.525662	0.550408
0.573679	0.595571	0.616112	0.635326	0.653252	0.669982	0.685449	0.699557
0.712206	0.723364	0.733278	0.741808	0.748745	0.753879	0.757158	0.758960
0.759035	0.757061	0.752715	0.746163	0.738157	0.727768	0.713964	0.695717
0.673644	0.649201	0.619779	0.582656	0.535106	0.471432	0.388151	0.288438
0.175521	0.013017						
0.017312	0.073211	0.129110	0.185010	0.240909	0.296809	0.352708	0.408608
0.464507	0.520407	0.576306	0.632205	0.688105	0.744004	0.799904	0.855803
0.911703	0.967602	1.023501	1.079400	1.135299	1.191197	1.247096	1.302995
1.358893	1.414792	1.470691	1.526589	1.582488	1.638387	1.694285	1.750184
1.806083	1.861981	1.917880	1.973779	2.029677	2.085576	2.141475	2.197373
2.253272	2.309171	2.365069	2.420968	2.476867	2.532765	2.588664	2.644563
2.700461	2.756385						
-0.002965	0.033477	0.068385	0.101781	0.134264	0.165401	0.195037	0.223301
0.250263	0.275941	0.299731	0.322290	0.343990	0.364667	0.384159	0.402315
0.419238	0.434997	0.449600	0.463054	0.475362	0.486496	0.496492	0.505404
0.513284	0.520176	0.526056	0.530910	0.534730	0.537509	0.539315	0.540335
0.540328	0.539011	0.536102	0.531837	0.527023	0.520620	0.511475	0.498439
0.481799	0.462963	0.440121	0.411366	0.374794	0.327186	0.266951	0.195864
0.115721	0.004852						
GG-GG	4.9250	2.887002	0.380690	1.618849	66.11070		
0.013053	0.010966	0.007082	0.014382	2.878139	0.011328		
0.003633	0.062542	0.121450	0.180359	0.239267	0.298176	0.357084	0.415992
0.474901	0.533809	0.592718	0.651626	0.710535	0.769443	0.828352	0.887260
0.946169	1.005076	1.063985	1.122893	1.181802	1.240710	1.299619	1.358527
1.417436	1.476344	1.535253	1.594161	1.653069	1.711978	1.770886	1.829795
1.888703	1.947612	2.006520	2.065429	2.124337	2.183246	2.242154	2.301063
2.359971	2.418880	2.477788	2.536696	2.595605	2.654513	2.713422	2.772330
2.831239	2.890150						
0.017881	0.058136	0.097355	0.134586	0.170443	0.204626	0.236981	0.267677
0.296917	0.324703	0.349931	0.373339	0.395539	0.416442	0.435963	0.454019
0.470621	0.485852	0.499790	0.512511	0.524092	0.534560	0.543848	0.551884
0.558593	0.563930	0.568005	0.570783	0.572204	0.572206	0.570790	0.568104
0.564015	0.558360	0.550976	0.542052	0.532125	0.520433	0.506138	0.488405
0.467372	0.443983	0.417042	0.385287	0.347455	0.301788	0.247352	0.184633
0.114124	0.019234						
0.017252	0.075431	0.133610	0.191789	0.249967	0.308146	0.366325	0.424504
0.482683	0.540862	0.599040	0.657219	0.715398	0.773577	0.831756	0.889935
0.948114	1.006292	1.064470	1.122648	1.180826	1.239004	1.297182	1.355360
1.413538	1.471716	1.529894	1.588072	1.646250	1.704428	1.762606	1.820784
1.878962	1.937140	1.995317	2.053495	2.111673	2.169851	2.228029	2.286207
2.344385	2.402563	2.460741	2.518919	2.577097	2.635275	2.693453	2.751631
2.809809	2.868018						
-0.004358	0.027839	0.058730	0.087732	0.115395	0.141552	0.166097	0.189138
0.210836	0.231193	0.249142	0.265328	0.280345	0.294156	0.306726	0.318015
0.327996	0.336730	0.344296	0.350773	0.356214	0.360474	0.363621	0.365785
0.367098	0.367627	0.367145	0.365773	0.363693	0.361093	0.358154	0.354871
0.351029	0.346405	0.340775	0.334243	0.327328	0.319428	0.309874	0.297996
0.283834	0.268139	0.250204	0.229275	0.204601	0.175645	0.142170	0.103758
0.059990	0.001110						

HH-HH	5.1960	2.988033	0.306919	1.669887	60.54451		
0.012974	0.011293	0.006387	0.014774	2.975735	0.008187		
0.004829	0.065658	0.126487	0.187317	0.248146	0.308975	0.369804	0.430634
0.491463	0.552292	0.613121	0.673950	0.734780	0.795609	0.856438	0.917267
0.978097	1.038925	1.099754	1.160583	1.221413	1.282242	1.343071	1.403900
1.464729	1.525558	1.586388	1.647217	1.708046	1.768875	1.829704	1.890533
1.951363	2.012192	2.073021	2.133850	2.194679	2.255508	2.316338	2.377167
2.437996	2.498825	2.559654	2.620483	2.681313	2.742142	2.802971	2.863800
2.924629	2.985463						
0.017636	0.052820	0.087044	0.119497	0.150724	0.180531	0.208805	0.235659
0.261216	0.285478	0.307723	0.328656	0.348679	0.367592	0.385196	0.401309
0.416075	0.429559	0.441739	0.452592	0.462118	0.470467	0.477546	0.483203
0.487287	0.489679	0.490490	0.489753	0.487477	0.483670	0.478330	0.471425
0.462970	0.452984	0.441486	0.428539	0.414193	0.398279	0.380616	0.361023
0.339622	0.316680	0.291714	0.264217	0.233684	0.199529	0.161512	0.119760
0.074399	0.019306						
0.016889	0.077144	0.137399	0.197655	0.257910	0.318165	0.378421	0.438676
0.498931	0.559187	0.619442	0.679698	0.739953	0.800208	0.860464	0.920719
0.980974	1.041229	1.101484	1.161739	1.221994	1.282249	1.342505	1.402760
1.463015	1.523270	1.583525	1.643780	1.704035	1.764290	1.824545	1.884800
1.945055	2.005310	2.065565	2.125820	2.186075	2.246330	2.306585	2.366840
2.427095	2.487350	2.547606	2.607861	2.668116	2.728371	2.788626	2.848881
2.909136	2.969402						
-0.005318	0.023765	0.051264	0.076883	0.101242	0.124193	0.145637	0.165671
0.184413	0.201861	0.217321	0.231482	0.244736	0.256894	0.267762	0.277171
0.285257	0.292074	0.297588	0.301767	0.304561	0.305858	0.305786	0.304521
0.302237	0.299012	0.294485	0.288870	0.282483	0.275641	0.268555	0.260976
0.252864	0.244223	0.235053	0.225407	0.215356	0.204763	0.193479	0.181354
0.168471	0.155057	0.140804	0.125385	0.108475	0.089927	0.069755	0.047777
0.023809	-0.005162						
JJ-JJ	5.3280	3.006474	0.292359	1.685557	58.67824		
0.012606	0.011112	0.005951	0.013968	2.994081	0.006445		
0.005062	0.066227	0.127393	0.188558	0.249723	0.310889	0.372054	0.433220
0.494385	0.555551	0.616716	0.677882	0.739047	0.800213	0.861378	0.922543
0.983709	1.044874	1.106039	1.167204	1.228369	1.289534	1.350698	1.411863
1.473028	1.534193	1.595358	1.656523	1.717688	1.778852	1.840017	1.901182
1.962347	2.023512	2.084677	2.145842	2.207006	2.268171	2.329336	2.390501
2.451666	2.512831	2.573996	2.635160	2.696325	2.757490	2.818655	2.879820
2.940985	3.002172						
0.017009	0.050713	0.083420	0.114388	0.144165	0.172626	0.199692	0.225437
0.249947	0.273229	0.294645	0.314859	0.334232	0.352572	0.369685	0.385397
0.399842	0.413082	0.425100	0.435878	0.445423	0.453899	0.461195	0.467135
0.471543	0.474310	0.475670	0.475549	0.473807	0.470307	0.464960	0.457877
0.449049	0.438445	0.426035	0.411731	0.395428	0.377284	0.357469	0.336155
0.313468	0.289293	0.263448	0.235752	0.206022	0.173803	0.138850	0.101544
0.062267	0.017830						
0.016353	0.077031	0.137709	0.198386	0.259064	0.319742	0.380419	0.441097
0.501774	0.562452	0.623130	0.683807	0.744485	0.805163	0.865840	0.926518
0.987196	1.047873	1.108550	1.169228	1.229905	1.290583	1.351260	1.411938
1.472615	1.533293	1.593970	1.654648	1.715325	1.776003	1.836680	1.897358
1.958035	2.018713	2.079391	2.140068	2.200746	2.261423	2.322101	2.382778
2.443456	2.504133	2.564811	2.625488	2.686166	2.746843	2.807521	2.868198
2.928876	2.989561						
-0.005513	0.022505	0.048932	0.073564	0.097019	0.119126	0.139783	0.159088
0.177151	0.193971	0.208888	0.222575	0.235399	0.247164	0.257674	0.266752
0.274518	0.281039	0.286304	0.290300	0.293003	0.294316	0.294335	0.293198
0.291041	0.287944	0.283706	0.278406	0.272184	0.265178	0.257442	0.248770
0.239271	0.229090	0.218374	0.207161	0.195268	0.182795	0.169858	0.156578
0.143070	0.129297	0.115099	0.100313	0.084776	0.068371	0.051117	0.033032
0.014136	-0.006773						

KK-KK	5.4610	3.014094	0.291935	1.703578	57.32002		
0.012343	0.010949	0.005697	0.013549	3.001851	0.005806		
0.005183	0.066493	0.127803	0.189113	0.250423	0.311733	0.373044	0.434354
0.495664	0.556974	0.618284	0.679594	0.740904	0.802214	0.863524	0.924835
0.986145	1.047455	1.108765	1.170074	1.231384	1.292694	1.354004	1.415314
1.476624	1.537933	1.599243	1.660553	1.721863	1.783173	1.844482	1.905792
1.967102	2.028412	2.089722	2.151031	2.212341	2.273651	2.334961	2.396271
2.457581	2.518890	2.580200	2.641510	2.702820	2.764130	2.825439	2.886749
2.948059	3.009381						
0.016610	0.049237	0.080864	0.110866	0.139779	0.167453	0.193800	0.218902
0.242845	0.265634	0.286690	0.306633	0.325793	0.343990	0.361043	0.376786
0.391338	0.404762	0.417047	0.428183	0.438189	0.447248	0.455223	0.461905
0.467083	0.470624	0.472806	0.473544	0.472675	0.470038	0.465527	0.459267
0.451261	0.441488	0.429927	0.416598	0.401542	0.384644	0.365781	0.344827
0.321634	0.296173	0.268586	0.239022	0.207628	0.173699	0.136758	0.097966
0.058496	0.017069						
0.015979	0.076837	0.137694	0.198552	0.259410	0.320268	0.381126	0.441984
0.502841	0.563699	0.624557	0.685415	0.746273	0.807131	0.867988	0.928846
0.989704	1.050561	1.111419	1.172276	1.233134	1.293992	1.354850	1.415708
1.476565	1.537423	1.598281	1.659139	1.719996	1.780854	1.841712	1.902570
1.963428	2.024285	2.085143	2.146001	2.206859	2.267716	2.328574	2.389432
2.450290	2.511147	2.572005	2.632863	2.693721	2.754579	2.815436	2.876294
2.937152	2.998013						
-0.005574	0.021869	0.047682	0.071779	0.094779	0.116491	0.136810	0.155833
0.173666	0.190306	0.205125	0.218768	0.231586	0.243386	0.253980	0.263190
0.271129	0.277865	0.283397	0.287724	0.290832	0.292635	0.293213	0.292678
0.291147	0.288683	0.285103	0.280490	0.274977	0.268699	0.261739	0.253974
0.245407	0.236058	0.225948	0.215087	0.203452	0.191042	0.177854	0.163888
0.149005	0.133089	0.116434	0.099349	0.082140	0.064740	0.046881	0.028810
0.010783	-0.007190						
LL-LL	5.7600	3.042852	0.289421	1.739626	54.35689		
0.011548	0.010403	0.005011	0.013504	3.031006	0.006484		
0.005331	0.067240	0.129149	0.191058	0.252968	0.314877	0.376786	0.438695
0.500604	0.562513	0.624422	0.686331	0.748240	0.810149	0.872058	0.933967
0.995876	1.057785	1.119694	1.181602	1.243511	1.305420	1.367329	1.429237
1.491146	1.553055	1.614964	1.676872	1.738781	1.800690	1.862598	1.924507
1.986416	2.048325	2.110233	2.172142	2.234051	2.295959	2.357868	2.419777
2.481686	2.543594	2.605503	2.667412	2.729321	2.791229	2.853138	2.915047
2.976955	3.038879						
0.015385	0.045905	0.075248	0.103195	0.130325	0.156333	0.181073	0.204695
0.227338	0.248985	0.269156	0.288388	0.306955	0.324695	0.341446	0.357059
0.371626	0.385210	0.397816	0.409450	0.420147	0.430118	0.439189	0.447100
0.453591	0.458509	0.462237	0.464625	0.465417	0.464358	0.461287	0.456427
0.449765	0.441249	0.430829	0.418495	0.404295	0.388148	0.369963	0.349651
0.327130	0.302389	0.275448	0.246331	0.215057	0.180957	0.143582	0.103831
0.062615	0.017456						
0.014869	0.076332	0.137795	0.199259	0.260722	0.322185	0.383649	0.445112
0.506575	0.568039	0.629502	0.690965	0.752428	0.813892	0.875355	0.936818
0.998282	1.059745	1.121207	1.182670	1.244132	1.305594	1.367057	1.428519
1.489982	1.551444	1.612906	1.674369	1.735831	1.797294	1.858756	1.920218
1.981681	2.043143	2.104606	2.166068	2.227530	2.288993	2.350455	2.411918
2.473380	2.534842	2.596305	2.657767	2.719230	2.780692	2.842155	2.903617
2.965079	3.026572						
-0.005638	0.020441	0.044837	0.067674	0.089576	0.110311	0.129773	0.148054
0.165244	0.181340	0.195786	0.209175	0.221819	0.233534	0.244136	0.253455
0.261577	0.268582	0.274491	0.279325	0.283094	0.285730	0.287278	0.287814
0.287414	0.286128	0.283865	0.280647	0.276522	0.271534	0.265711	0.259007
0.251423	0.242971	0.233661	0.223485	0.212412	0.200471	0.187693	0.174111
0.159706	0.144421	0.128318	0.111459	0.093911	0.075456	0.055934	0.035713
0.015164	-0.006273						

CA135100.N2353F8

TITLE

BLADE & DISK (OD) CATEGORY 1 P/N4060023 NO REV EMD4060023 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
W.THOMAS	R.L.WALLS	830823	R.L.SANFORD	830823

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
31154B			237441	1	4060023 NO REV	4060023 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

BLADE & DISK (OD) CATEGORY 1 P/N4060023 NO REV EMD4060023 NO REV

11	50	1	1				
A-A	* 5.1300	2.884295	0.327835	1.627526	64.38498		
0.009176	0.008296	0.003921	0.014332	2.872739	0.008478		
0.004030	0.062785	0.121540	0.180295	0.239051	0.297806	0.356561	0.415316
0.474072	0.532827	0.591582	0.650337	0.709092	0.767848	0.826603	0.885358
0.944113	1.002868	1.061623	1.120378	1.179132	1.237887	1.296642	1.355397
1.414152	1.472907	1.531662	1.590417	1.649172	1.707927	1.766682	1.825437
1.884192	1.942946	2.001701	2.060456	2.119211	2.177966	2.236721	2.295476
2.354231	2.412986	2.471741	2.530496	2.589251	2.648005	2.706760	2.765515
2.824270	2.883037						
0.012045	0.043049	0.073458	0.102782	0.131362	0.159007	0.185641	0.211311
0.236064	0.259908	0.282284	0.303711	0.324480	0.344425	0.363382	0.381204
0.398012	0.413855	0.428701	0.442521	0.455322	0.467336	0.478403	0.488266
0.496670	0.503459	0.508992	0.513148	0.515707	0.516450	0.515274	0.512464
0.507890	0.501371	0.492727	0.481960	0.469342	0.454573	0.437318	0.417239
0.394325	0.368858	0.340428	0.308603	0.272951	0.232155	0.185594	0.134654
0.080737	0.018442						
0.011689	0.069927	0.128165	0.186403	0.244642	0.302880	0.361118	0.419356
0.477594	0.535833	0.594071	0.652309	0.710547	0.768785	0.827024	0.885262
0.943500	1.001738	1.059976	1.118214	1.176452	1.234690	1.292928	1.351166
1.409404	1.467642	1.525880	1.584118	1.642356	1.700594	1.758832	1.817070
1.875308	1.933546	1.991784	2.050022	2.108260	2.166498	2.224736	2.282974
2.341212	2.399450	2.457688	2.515926	2.574164	2.632402	2.690640	2.748878
2.807117	2.865362						
-0.004605	0.018693	0.041444	0.063303	0.084519	0.104888	0.124329	0.142886
0.160591	0.177453	0.192943	0.207562	0.221570	0.234791	0.247047	0.258178
0.268325	0.277525	0.285730	0.292891	0.298958	0.303900	0.307788	0.310711
0.312756	0.313983	0.314304	0.313732	0.312304	0.310057	0.307060	0.303393
0.298901	0.293411	0.286752	0.278915	0.270167	0.260276	0.248975	0.235999
0.221362	0.205350	0.187679	0.168049	0.146160	0.121288	0.093253	0.062970
0.031363	-0.003809						

* This dimension is the radial distance from the rig centerline to the airfoil manufacturing cross section. For further definition, see drawing T4060023.

B-B	5.7600	2.976188	0.196792	1.674297	54.94168		
0.008617	0.008285	0.002370	0.010067	2.966837	0.003731		
0.005534	0.066075	0.126615	0.187156	0.247696	0.308237	0.368777	0.429318
0.489858	0.550398	0.610939	0.671479	0.732020	0.792560	0.853101	0.913641
0.974181	1.034721	1.095262	1.155802	1.216342	1.276882	1.337422	1.397963
1.458503	1.519043	1.579583	1.640123	1.700664	1.761204	1.821744	1.882284
1.942824	2.003365	2.063905	2.124445	2.184985	2.245525	2.306066	2.366606
2.427146	2.487686	2.548226	2.608767	2.669307	2.729847	2.790387	2.850927
2.911468	2.972017						
0.010537	0.031033	0.051073	0.070386	0.089209	0.107447	0.125065	0.142068
0.158464	0.174260	0.189094	0.203310	0.217093	0.230326	0.242893	0.254688
0.265782	0.276212	0.285968	0.295040	0.303443	0.311329	0.318580	0.325012
0.330441	0.334761	0.338245	0.340780	0.342181	0.342258	0.340908	0.338330
0.334473	0.329250	0.322575	0.314453	0.305021	0.294134	0.281630	0.267348
0.251266	0.233527	0.213996	0.192531	0.168991	0.142801	0.113691	0.082334
0.049412	0.012362						
0.010240	0.070533	0.130826	0.191118	0.251411	0.311704	0.371997	0.432289
0.492582	0.552875	0.613168	0.673460	0.733753	0.794046	0.854338	0.914631
0.974924	1.035216	1.095509	1.155801	1.216093	1.276385	1.336678	1.396970
1.457262	1.517554	1.577847	1.638139	1.698431	1.758723	1.819016	1.879308
1.939600	1.999892	2.060184	2.120477	2.180769	2.241061	2.301353	2.361646
2.421938	2.482230	2.542522	2.602815	2.663107	2.723399	2.783691	2.843984
2.904276	2.964586						
-0.006023	0.008144	0.021782	0.034751	0.047268	0.059210	0.070522	0.081235
0.091381	0.100960	0.109586	0.117599	0.125183	0.132219	0.138589	0.144188
0.149106	0.153366	0.156932	0.159770	0.161835	0.163057	0.163525	0.163361
0.162684	0.161570	0.159858	0.157603	0.154905	0.151862	0.148553	0.144929
0.140937	0.136534	0.131674	0.126352	0.120638	0.114476	0.107803	0.100556
0.092726	0.084374	0.075466	0.065965	0.055832	0.044906	0.033121	0.020696
0.007848	-0.006082						
C-C	6.2000	3.078791	0.132839	1.725074	49.33621		
0.008191	0.008042	0.001555	0.009737	3.069333	0.002318		
0.006137	0.068724	0.131311	0.193898	0.256485	0.319073	0.381660	0.444247
0.506834	0.569421	0.632008	0.694595	0.757182	0.819769	0.882356	0.944943
1.007530	1.070117	1.132704	1.195291	1.257877	1.320464	1.383051	1.445638
1.508224	1.570811	1.633398	1.695985	1.758572	1.821158	1.883745	1.946332
2.008919	2.071506	2.134092	2.196679	2.259266	2.321853	2.384439	2.447026
2.509613	2.572200	2.634787	2.697373	2.759960	2.822547	2.885134	2.947721
3.010307	3.072906						
0.009522	0.024553	0.039312	0.053589	0.067531	0.081066	0.094164	0.106829
0.119066	0.130879	0.141989	0.152647	0.162989	0.172925	0.182365	0.191228
0.199568	0.207412	0.214750	0.221575	0.227895	0.233834	0.239296	0.244132
0.248192	0.251393	0.253959	0.255793	0.256735	0.256622	0.255358	0.253094
0.249814	0.245472	0.240025	0.233472	0.225879	0.217181	0.207303	0.196170
0.183753	0.170100	0.155201	0.139042	0.121608	0.102533	0.081620	0.059397
0.036402	0.011376						
0.009216	0.071651	0.134086	0.196520	0.258955	0.321390	0.383824	0.446259
0.508694	0.571129	0.633563	0.695998	0.758433	0.820868	0.883302	0.945737
1.008171	1.070605	1.133039	1.195474	1.257908	1.320342	1.382776	1.445210
1.507645	1.570079	1.632513	1.694947	1.757381	1.819816	1.882250	1.944684
2.007118	2.069552	2.131987	2.194421	2.256855	2.319289	2.381723	2.444158
2.506592	2.569026	2.631460	2.693894	2.756329	2.818763	2.881197	2.943631
3.006065	3.068521						
-0.006551	0.002565	0.011381	0.019746	0.027791	0.035427	0.042619	0.049378
0.055712	0.061624	0.066852	0.071650	0.076146	0.080238	0.083828	0.086825
0.089302	0.091280	0.092733	0.093638	0.093958	0.093608	0.092681	0.091311
0.089626	0.087707	0.085363	0.082671	0.079761	0.076760	0.073761	0.070667
0.067454	0.064111	0.060626	0.056995	0.053229	0.049324	0.045278	0.041085
0.036725	0.032185	0.027508	0.022735	0.017911	0.013024	0.008033	0.002965
-0.002150	-0.007386						

D-D	6.7000	3.180624	0.061743	1.768847	44.33003		
0.007849	0.007806	0.000821	0.009367	3.171285	0.000737		
0.006667	0.071291	0.135914	0.200538	0.265161	0.329784	0.394408	0.459031
0.523654	0.588278	0.652901	0.717524	0.782148	0.846771	0.911394	0.976018
1.040641	1.105264	1.169887	1.234509	1.299132	1.363755	1.428378	1.493001
1.557624	1.622247	1.686870	1.751493	1.816115	1.880738	1.945361	2.009984
2.074607	2.139230	2.203853	2.268476	2.333098	2.397721	2.462344	2.526967
2.591590	2.656213	2.720836	2.785459	2.850081	2.914704	2.979327	3.043950
3.108573	3.173214						
0.008587	0.018101	0.027431	0.036446	0.045247	0.053768	0.061983	0.069902
0.077529	0.084865	0.091751	0.098358	0.104764	0.110907	0.116724	0.122158
0.127244	0.132003	0.136430	0.140522	0.144289	0.147810	0.151021	0.153821
0.156113	0.157836	0.159132	0.159947	0.160181	0.159741	0.158561	0.156722
0.154228	0.151074	0.147251	0.142755	0.137588	0.131753	0.125254	0.118093
0.110252	0.101712	0.092511	0.082691	0.072294	0.061151	0.049141	0.036543
0.023633	0.009904						
0.008287	0.072846	0.137406	0.201966	0.266525	0.331085	0.395645	0.460204
0.524764	0.589323	0.653883	0.718443	0.783002	0.847562	0.912122	0.976681
1.041241	1.105800	1.170359	1.234918	1.299477	1.364036	1.428595	1.493154
1.557713	1.622272	1.686831	1.751390	1.815948	1.880507	1.945066	2.009625
2.074184	2.138743	2.203302	2.267861	2.332420	2.396979	2.461538	2.526097
2.590656	2.655215	2.719774	2.784333	2.848892	2.913451	2.978010	3.042569
3.107128	3.171710						
-0.007013	-0.002992	0.000802	0.004287	0.007561	0.010538	0.013171	0.015504
0.017590	0.019419	0.020779	0.021833	0.022674	0.023245	0.023490	0.023357
0.022885	0.022088	0.020955	0.019476	0.017620	0.015257	0.012507	0.009545
0.006549	0.003622	0.000509	-0.002685	-0.005788	-0.008624	-0.011076	-0.013286
-0.015270	-0.017023	-0.018543	-0.019836	-0.020922	-0.021774	-0.022363	-0.022659
-0.022659	-0.022394	-0.021850	-0.021010	-0.019859	-0.018318	-0.016355	-0.014080
-0.011606	-0.008622						
E-E	7.3400	3.290259	0.009988	1.826573	41.94035		
0.007469	0.007439	0.000665	0.010256	3.280018	-0.000568		
0.006531	0.073351	0.140171	0.206991	0.273810	0.340630	0.407450	0.474270
0.541090	0.607910	0.674730	0.741550	0.808370	0.875190	0.942010	1.008829
1.075648	1.142467	1.209287	1.276106	1.342925	1.409744	1.476563	1.543383
1.610202	1.677021	1.743840	1.810659	1.877479	1.944298	2.011117	2.077936
2.144755	2.211575	2.278394	2.345213	2.412032	2.478851	2.545671	2.612490
2.679309	2.746128	2.812947	2.879766	2.946586	3.013405	3.080224	3.147043
3.213862	3.280708						
0.008079	0.016350	0.024256	0.031575	0.038494	0.044950	0.050889	0.056368
0.061454	0.066134	0.070204	0.073854	0.077211	0.080239	0.082906	0.085178
0.087063	0.088580	0.089742	0.090562	0.091042	0.091132	0.090866	0.090302
0.089497	0.088488	0.087205	0.085667	0.083910	0.081973	0.079879	0.077595
0.075122	0.072464	0.069626	0.066601	0.063374	0.059966	0.056403	0.052709
0.048877	0.044872	0.040732	0.036495	0.032200	0.027815	0.023302	0.018734
0.014185	0.009665						
0.007773	0.074584	0.141396	0.208207	0.275019	0.341830	0.408642	0.475453
0.542264	0.609076	0.675887	0.742699	0.809510	0.876322	0.943133	1.009944
1.076755	1.143565	1.210376	1.277186	1.343997	1.410808	1.477618	1.544429
1.611239	1.678050	1.744861	1.811671	1.878482	1.945292	2.012103	2.078914
2.145724	2.212535	2.279346	2.346156	2.412967	2.479777	2.546588	2.613399
2.680209	2.747020	2.813830	2.880641	2.947452	3.014262	3.081073	3.147883
3.214694	3.281534						
-0.006796	-0.003703	-0.001020	0.001103	0.002837	0.004104	0.004841	0.005118
0.005015	0.004522	0.003424	0.001913	0.000112	-0.002019	-0.004519	-0.007428
-0.010739	-0.014428	-0.018478	-0.022873	-0.027634	-0.033029	-0.038843	-0.044755
-0.050441	-0.055702	-0.060974	-0.066102	-0.070805	-0.074806	-0.077920	-0.080369
-0.082183	-0.083355	-0.083878	-0.083764	-0.083047	-0.081707	-0.079722	-0.077067
-0.073750	-0.069803	-0.065189	-0.059870	-0.053807	-0.046775	-0.038694	-0.029912
-0.020779	-0.010712						

F-F	7.6000	3.332760	0.001335	1.848370	39.29941		
0.007290	0.007269	0.000556	0.009475	3.323314	-0.000746		
0.006428	0.074124	0.141821	0.209518	0.277215	0.344912	0.412609	0.480305
0.548002	0.615699	0.683396	0.751093	0.818789	0.886486	0.954183	1.021879
1.089576	1.157272	1.224969	1.292665	1.360362	1.428059	1.495755	1.563452
1.631148	1.698845	1.766541	1.834238	1.901935	1.969631	2.037328	2.105024
2.172721	2.240417	2.308114	2.375811	2.443507	2.511204	2.578900	2.646597
2.714293	2.781990	2.849687	2.917383	2.985080	3.052776	3.120473	3.188169
3.255866	3.323572						
0.007797	0.015721	0.023402	0.030612	0.037489	0.043962	0.049996	0.055607
0.060810	0.065607	0.069726	0.073396	0.076752	0.079726	0.082249	0.084256
0.085778	0.086841	0.087454	0.087621	0.087337	0.086522	0.085241	0.083593
0.081676	0.079548	0.077058	0.074272	0.071299	0.068249	0.065182	0.061976
0.058667	0.055307	0.051951	0.048610	0.045215	0.041809	0.038444	0.035170
0.031990	0.028852	0.025789	0.022839	0.020040	0.017418	0.014963	0.012666
0.010516	0.008725						
0.007560	0.075263	0.142966	0.210669	0.278372	0.346076	0.413779	0.481482
0.549185	0.616888	0.684591	0.752294	0.819997	0.887701	0.955404	1.023107
1.090809	1.158511	1.226213	1.293916	1.361618	1.429320	1.497023	1.564725
1.632427	1.700130	1.767832	1.835534	1.903236	1.970939	2.038641	2.106343
2.174046	2.241748	2.309450	2.377152	2.444855	2.512557	2.580259	2.647962
2.715664	2.783366	2.851068	2.918771	2.986473	3.054175	3.121878	3.189580
3.257282	3.325014						
-0.006728	-0.003943	-0.001457	0.000589	0.002324	0.003663	0.004568	0.005057
0.005143	0.004836	0.003880	0.002503	0.000830	-0.001217	-0.003718	-0.006744
-0.010260	-0.014237	-0.018669	-0.023554	-0.028929	-0.035083	-0.041774	-0.048641
-0.055322	-0.061599	-0.067981	-0.074271	-0.080128	-0.085209	-0.089302	-0.092712
-0.095432	-0.097401	-0.098561	-0.098900	-0.098496	-0.097299	-0.095249	-0.092286
-0.088399	-0.083642	-0.077990	-0.071417	-0.063897	-0.055123	-0.044974	-0.033944
-0.022530	-0.010068						
G-G	7.8600	3.379615	-0.014158	1.873916	36.39374		
0.007059	0.007053	0.000291	0.009350	3.370298	-0.000800		
0.006443	0.075095	0.143748	0.212400	0.281053	0.349705	0.418358	0.487010
0.555663	0.624315	0.692967	0.761620	0.830272	0.898925	0.967577	1.036229
1.104881	1.173533	1.242186	1.310838	1.379490	1.448142	1.516794	1.585446
1.654099	1.722751	1.791403	1.860055	1.928707	1.997359	2.066011	2.134664
2.203316	2.271968	2.340620	2.409272	2.477924	2.546576	2.615229	2.683881
2.752533	2.821185	2.889837	2.958489	3.027142	3.095794	3.164446	3.233098
3.301750	3.370416						
0.007323	0.013386	0.018927	0.023914	0.028573	0.032945	0.037042	0.040839
0.044325	0.047506	0.050228	0.052652	0.054864	0.056816	0.058460	0.059752
0.060702	0.061336	0.061671	0.061722	0.061496	0.060945	0.060100	0.059014
0.057740	0.056308	0.054633	0.052755	0.050739	0.048649	0.046516	0.044260
0.041914	0.039525	0.037140	0.034769	0.032347	0.029917	0.027529	0.025234
0.023034	0.020878	0.018798	0.016831	0.015014	0.013373	0.011900	0.010580
0.009397	0.008549						
0.007142	0.075812	0.144483	0.213153	0.281824	0.350494	0.419165	0.487835
0.556506	0.625176	0.693847	0.762517	0.831188	0.899858	0.968529	1.037199
1.105869	1.174540	1.243210	1.311880	1.380550	1.449221	1.517891	1.586561
1.655231	1.723902	1.792572	1.861242	1.929913	1.998583	2.067253	2.135923
2.204594	2.273264	2.341934	2.410604	2.479275	2.547945	2.616615	2.685286
2.753956	2.822626	2.891296	2.959967	3.028637	3.097307	3.165977	3.234648
3.303318	3.371999						
-0.006767	-0.005785	-0.005298	-0.005288	-0.005612	-0.006235	-0.007154	-0.008373
-0.009873	-0.011657	-0.013885	-0.016402	-0.019124	-0.022099	-0.025377	-0.029002
-0.032959	-0.037226	-0.041792	-0.046644	-0.051811	-0.057539	-0.063628	-0.069768
-0.075655	-0.081102	-0.086544	-0.091811	-0.096613	-0.100661	-0.103775	-0.106215
-0.107972	-0.108992	-0.109221	-0.108648	-0.107344	-0.105264	-0.102356	-0.098566
-0.093884	-0.088358	-0.081966	-0.074682	-0.066483	-0.057054	-0.046279	-0.034675
-0.022764	-0.009995						

H-H	8.3000	3.457278	-0.035041	1.915045	32.47598		
0.006542	0.006540	-0.000146	0.009128	3.448189	-0.000860		
0.006418	0.076658	0.146898	0.217138	0.287378	0.357618	0.427858	0.498097
0.568337	0.638577	0.708817	0.779057	0.849297	0.919537	0.989777	1.060017
1.130256	1.200495	1.270734	1.340973	1.411212	1.481451	1.551690	1.621929
1.692168	1.762407	1.832646	1.902885	1.973125	2.043364	2.113603	2.183842
2.254081	2.324320	2.394559	2.464798	2.535037	2.605276	2.675515	2.745754
2.815993	2.886232	2.956471	3.026711	3.096950	3.167189	3.237428	3.307667
3.377906	3.448174						
0.006394	0.007689	0.009023	0.010546	0.012241	0.013911	0.015521	0.017063
0.018477	0.019781	0.020898	0.021883	0.022779	0.023574	0.024254	0.024808
0.025234	0.025540	0.025737	0.025835	0.025845	0.025784	0.025648	0.025429
0.025118	0.024706	0.024183	0.023566	0.022871	0.022118	0.021310	0.020410
0.019447	0.018454	0.017465	0.016485	0.015465	0.014439	0.013450	0.012537
0.011705	0.010915	0.010187	0.009546	0.009015	0.008612	0.008333	0.008171
0.008117	0.008269						
0.006206	0.076485	0.146763	0.217042	0.287320	0.357599	0.427877	0.498155
0.568434	0.638712	0.708991	0.779269	0.849548	0.919826	0.990105	1.060383
1.130661	1.200939	1.271217	1.341496	1.411774	1.482052	1.552330	1.622608
1.692886	1.763165	1.833443	1.903721	1.973999	2.044277	2.114555	2.184834
2.255112	2.325390	2.395668	2.465946	2.536224	2.606503	2.676781	2.747059
2.817337	2.887615	2.957893	3.028172	3.098450	3.168728	3.239006	3.309284
3.379562	3.449852						
-0.006679	-0.010288	-0.013854	-0.017199	-0.020338	-0.023497	-0.026721	-0.030007
-0.033407	-0.036905	-0.040554	-0.044297	-0.048109	-0.052008	-0.056015	-0.060151
-0.064414	-0.068790	-0.073269	-0.077835	-0.082509	-0.087488	-0.092612	-0.097641
-0.102331	-0.106537	-0.110600	-0.114387	-0.117672	-0.120228	-0.121913	-0.122931
-0.123275	-0.122906	-0.121784	-0.119900	-0.117305	-0.113966	-0.109849	-0.104917
-0.099148	-0.092564	-0.085180	-0.077009	-0.068064	-0.058104	-0.047002	-0.035154
-0.022960	-0.009836						
J-J	9.2500	3.604960	-0.052353	2.020149	28.14662		
0.005923	0.005916	-0.000296	0.009253	3.595738	-0.000773		
0.006025	0.079281	0.152537	0.225793	0.299049	0.372305	0.445560	0.518816
0.592072	0.665328	0.738584	0.811840	0.885095	0.958351	1.031607	1.104862
1.178118	1.251373	1.324629	1.397884	1.471140	1.544395	1.617651	1.690907
1.764162	1.837418	1.910673	1.983929	2.057184	2.130440	2.203695	2.276951
2.350206	2.423462	2.496717	2.569973	2.643229	2.716484	2.789740	2.862995
2.936251	3.009506	3.082762	3.156017	3.229273	3.302528	3.375784	3.449039
3.522295	3.595563						
0.005627	0.004276	0.002898	0.001530	0.000176	-0.001149	-0.002442	-0.003703
-0.004929	-0.006120	-0.007233	-0.008312	-0.009366	-0.010365	-0.011276	-0.012080
-0.012888	-0.013649	-0.014246	-0.014561	-0.014484	-0.014017	-0.013251	-0.012278
-0.011189	-0.010013	-0.008519	-0.006865	-0.005278	-0.003983	-0.003174	-0.002782
-0.002634	-0.002561	-0.002392	-0.002037	-0.001631	-0.001189	-0.000714	-0.000210
0.000304	0.000816	0.001365	0.001993	0.002743	0.003647	0.004691	0.005842
0.007066	0.008478						
0.005485	0.078786	0.152086	0.225387	0.298688	0.371989	0.445290	0.518591
0.591891	0.665192	0.738493	0.811794	0.885095	0.958396	1.031696	1.104997
1.178297	1.251597	1.324898	1.398198	1.471498	1.544799	1.618099	1.691400
1.764700	1.838000	1.911301	1.984601	2.057901	2.131202	2.204502	2.277802
2.351103	2.424403	2.497704	2.571004	2.644304	2.717605	2.790905	2.864205
2.937506	3.010806	3.084106	3.157407	3.230707	3.304008	3.377308	3.450608
3.523909	3.597229						
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-0.047984	-0.053016	-0.057949	-0.062817	-0.067641	-0.072406	-0.077097	-0.081699
-0.086227	-0.090682	-0.095055	-0.099339	-0.103549	-0.107842	-0.112091	-0.116104
-0.119687	-0.122721	-0.125457	-0.127811	-0.129629	-0.130758	-0.131095	-0.130766
-0.129781	-0.128136	-0.125823	-0.122840	-0.119196	-0.114884	-0.109900	-0.104236
-0.097883	-0.090837	-0.083114	-0.074734	-0.065714	-0.055817	-0.044934	-0.033487
-0.021906	-0.009905						

K-K	9.7720	3.683251	-0.046504	2.033718	26.51585		
0.006102	0.006096	-0.000282	0.009079	3.674201	-0.000750		
0.006194	0.081050	0.155905	0.230760	0.305616	0.380471	0.455326	0.530182
0.605037	0.679892	0.754748	0.829603	0.904458	0.979314	1.054169	1.129024
1.203878	1.278733	1.353588	1.428443	1.503298	1.578153	1.653008	1.727862
1.802717	1.877572	1.952427	2.027282	2.102137	2.176991	2.251846	2.326701
2.401556	2.476411	2.551266	2.626121	2.700975	2.775830	2.850685	2.925540
3.000395	3.075250	3.150105	3.224959	3.299814	3.374669	3.449524	3.524379
3.599234	3.674108						
0.005820	0.004597	0.003417	0.002295	0.001213	0.000186	-0.000782	-0.001696
-0.002560	-0.003376	-0.004102	-0.004777	-0.005417	-0.005996	-0.006492	-0.006882
-0.007182	-0.007397	-0.007527	-0.007568	-0.007518	-0.007380	-0.007162	-0.006874
-0.006526	-0.006117	-0.005607	-0.005028	-0.004423	-0.003835	-0.003296	-0.002780
-0.002272	-0.001759	-0.001231	-0.000681	-0.000121	0.000452	0.001042	0.001653
0.002292	0.002962	0.003647	0.004334	0.005007	0.005651	0.006279	0.006914
0.007583	0.008329						
0.005681	0.080575	0.155469	0.230362	0.305256	0.380149	0.455043	0.529936
0.604830	0.679723	0.754617	0.829510	0.904404	0.979297	1.054191	1.129084
1.203977	1.278870	1.353763	1.428656	1.503549	1.578442	1.653335	1.728228
1.803121	1.878014	1.952907	2.027800	2.102693	2.177586	2.252479	2.327372
2.402265	2.477158	2.552051	2.626944	2.701837	2.776730	2.851623	2.926516
3.001409	3.076302	3.151195	3.226088	3.300981	3.375874	3.450767	3.525660
3.600553	3.675467						
-0.006370	-0.011470	-0.016566	-0.021613	-0.026619	-0.031579	-0.036494	-0.041353
-0.046142	-0.050866	-0.055466	-0.059990	-0.064462	-0.068858	-0.073157	-0.077338
-0.081425	-0.085418	-0.089302	-0.093063	-0.096706	-0.100351	-0.103906	-0.107229
-0.110178	-0.112665	-0.114892	-0.116782	-0.118200	-0.119012	-0.119128	-0.118660
-0.117616	-0.115987	-0.113764	-0.110941	-0.107525	-0.103516	-0.098917	-0.093726
-0.087930	-0.081512	-0.074508	-0.066953	-0.058884	-0.050119	-0.040552	-0.030512
-0.020332	-0.009740						
L-L	10.0500	3.717708	-0.041626	2.052864	25.74098		
0.006046	0.006040	-0.000263	0.008912	3.708819	-0.000664		
0.006146	0.081711	0.157275	0.232839	0.308404	0.383968	0.459532	0.535097
0.610661	0.686225	0.761790	0.837354	0.912918	0.988482	1.064046	1.139609
1.215173	1.290736	1.366300	1.441863	1.517426	1.592990	1.668553	1.744117
1.819680	1.895244	1.970807	2.046371	2.121934	2.197497	2.273061	2.348624
2.424188	2.499751	2.575315	2.650878	2.726441	2.802005	2.877568	2.953132
3.028695	3.104259	3.179822	3.255385	3.330949	3.406512	3.482076	3.557639
3.633203	3.708800						
0.005783	0.004441	0.003162	0.001990	0.000899	-0.000128	-0.001102	-0.002011
-0.002846	-0.003613	-0.004255	-0.004821	-0.005333	-0.005773	-0.006121	-0.006358
-0.006506	-0.006561	-0.006507	-0.006331	-0.006011	-0.005512	-0.004876	-0.004159
-0.003418	-0.002688	-0.001890	-0.001054	-0.000227	0.000540	0.001212	0.001821
0.002383	0.002909	0.003410	0.003891	0.004343	0.004767	0.005168	0.005548
0.005910	0.006252	0.006574	0.006876	0.007157	0.007415	0.007650	0.007867
0.008074	0.008248						
0.005646	0.081244	0.156842	0.232439	0.308037	0.383635	0.459232	0.534830
0.610428	0.686026	0.761623	0.837221	0.912819	0.988416	1.064013	1.139610
1.215207	1.290804	1.366401	1.441998	1.517594	1.593191	1.668788	1.744385
1.819982	1.895578	1.971175	2.046772	2.122369	2.197966	2.273562	2.349159
2.424756	2.500353	2.575950	2.651546	2.727143	2.802740	2.878337	2.953934
3.029531	3.105127	3.180724	3.256321	3.331918	3.407515	3.483111	3.558708
3.634305	3.709935						
-0.006296	-0.011248	-0.016142	-0.020999	-0.025847	-0.030621	-0.035307	-0.039907
-0.044406	-0.048809	-0.053077	-0.057271	-0.061409	-0.065462	-0.069401	-0.073201
-0.076883	-0.080453	-0.083902	-0.087220	-0.090414	-0.093588	-0.096660	-0.099506
-0.102005	-0.104077	-0.105887	-0.107379	-0.108451	-0.109002	-0.108964	-0.108408
-0.107338	-0.105748	-0.103628	-0.100974	-0.097787	-0.094073	-0.089841	-0.085095
-0.079826	-0.074016	-0.067695	-0.060892	-0.053637	-0.045779	-0.037229	-0.028249
-0.019106	-0.009506						

CA135500.N236347

TITLE

CASE-EXIT GUIDE VANE CATEGORY 1 P/N4060684 NO REV EMD4060686 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830823	R.L.SANFORD	830823

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
31154B			237442	1	4060684 NO REV	4060686 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

CASE-EXIT GUIDE VANE (OD) CAT 1 P/N4060686 NO REV EMD4060686 NO REV

9	25	3	0				
AA-AA	* 5.9900	0.947383	0.014523	-0.058385	93.25330		
0.044623	0.043558	-0.009690	0.008933	0.938689	-0.002055		
0.053174	0.089447	0.125820	0.162307	0.198883	0.235550	0.272298	0.309119
0.346007	0.382947	0.419932	0.456954	0.494004	0.531074	0.568152	0.605230
0.642298	0.679348	0.716375	0.753359	0.790281	0.827135	0.863953	0.900721
0.937382							
0.033885	0.026193	0.018992	0.012393	0.006304	0.000791	-0.004152	-0.008522
-0.012288	-0.015498	-0.018136	-0.020190	-0.021648	-0.022511	-0.022769	-0.022432
-0.021533	-0.020069	-0.018090	-0.015445	-0.012033	-0.007957	-0.003561	0.001228
0.006782							
0.034722	0.072243	0.109889	0.147672	0.185554	0.223529	0.261581	0.299693
0.337850	0.376032	0.414227	0.452419	0.490589	0.528720	0.566796	0.604802
0.642725	0.680555	0.718277	0.755849	0.793227	0.830428	0.867539	0.904479
0.941129							
-0.053430	-0.060573	-0.067032	-0.072634	-0.077519	-0.081619	-0.084928	-0.087448
-0.089188	-0.090181	-0.090400	-0.089811	-0.088417	-0.086205	-0.083184	-0.079379
-0.074819	-0.069544	-0.063549	-0.056676	-0.048819	-0.040156	-0.031114	-0.021408
-0.010649							
AB-AB	6.1350	0.943361	0.014315	-0.059365	92.09789		
0.045481	0.044461	-0.009578	0.008950	0.934636	-0.001993		
0.053992	0.090096	0.126292	0.162597	0.198983	0.235454	0.272000	0.308616
0.345294	0.382022	0.418793	0.455598	0.492430	0.529280	0.566139	0.603000
0.639853	0.676691	0.713509	0.750290	0.787016	0.823683	0.860317	0.896905
0.933399							
0.034893	0.027459	0.020493	0.014111	0.008215	0.002865	-0.001941	-0.006185
-0.009854	-0.012988	-0.015566	-0.017590	-0.019056	-0.019957	-0.020289	-0.020064
-0.019307	-0.018013	-0.016224	-0.013809	-0.010657	-0.006875	-0.002787	0.001683
0.006871							
0.035778	0.073109	0.110564	0.148147	0.185822	0.223584	0.261417	0.299307
0.337236	0.375190	0.413153	0.451110	0.489045	0.526941	0.564784	0.602558

* This dimension is the radial distance from the rig centerline to the airfoil manufacturing cross section. For further definition, see drawing T4060686 Sheet 1.

0.640253	0.677859	0.715361	0.752718	0.789892	0.826893	0.863808	0.900563
0.937042							
-0.054222	-0.061061	-0.067244	-0.072605	-0.077271	-0.081170	-0.084305	-0.086663
-0.088252	-0.089098	-0.089190	-0.088509	-0.087059	-0.084814	-0.081796	-0.078024
-0.073516	-0.068319	-0.062421	-0.055672	-0.047973	-0.039482	-0.030620	-0.021126
-0.010614							
AC-AC	6.3880	0.937718	0.013540	-0.061166	89.81125		
0.046966	0.046080	-0.009081	0.008982	0.928928	-0.001852		
0.055181	0.091082	0.127058	0.163125	0.199261	0.235466	0.271733	0.308058
0.344433	0.380851	0.417305	0.453791	0.490302	0.526831	0.563370	0.599913
0.636453	0.672984	0.709501	0.745992	0.782443	0.818848	0.855228	0.891572
0.927841							
0.036995	0.030177	0.023767	0.017883	0.012439	0.007480	0.002996	-0.000990
-0.004489	-0.007512	-0.010057	-0.012103	-0.013644	-0.014671	-0.015182	-0.015193
-0.014716	-0.013769	-0.012372	-0.010428	-0.007830	-0.004658	-0.001203	0.002600
0.007064							
0.037943	0.075023	0.112199	0.149479	0.186836	0.224265	0.261751	0.299283
0.336846	0.374426	0.412012	0.449590	0.487146	0.524665	0.562134	0.599541
0.636875	0.674125	0.711284	0.748312	0.785172	0.821876	0.858502	0.894989
0.931230							
-0.055337	-0.061474	-0.067006	-0.071792	-0.075940	-0.079372	-0.082106	-0.084128
-0.085447	-0.086085	-0.086022	-0.085248	-0.083743	-0.081503	-0.078536	-0.074872
-0.070523	-0.065511	-0.059859	-0.053410	-0.046059	-0.037962	-0.029519	-0.020503
-0.010535							
AD-AD	7.0690	0.933312	0.013334	-0.065562	87.41484		
0.051061	0.050266	-0.008974	0.008991	0.924471	-0.001637		
0.059335	0.094957	0.130643	0.166399	0.202214	0.238085	0.274006	0.309973
0.345980	0.382023	0.418097	0.454197	0.490318	0.526455	0.562604	0.598760
0.634917	0.671071	0.707219	0.743354	0.779465	0.815550	0.851619	0.887669
0.923677							
0.041276	0.035076	0.029260	0.023888	0.018919	0.014382	0.010255	0.006548
0.003262	0.000387	-0.002068	-0.004106	-0.005725	-0.006921	-0.007680	-0.008010
-0.007940	-0.007478	-0.006657	-0.005379	-0.003558	-0.001266	0.001253	0.004033
0.007319							
0.042432	0.079211	0.116076	0.153019	0.190027	0.227091	0.264199	0.301338
0.338498	0.375667	0.412834	0.449988	0.487116	0.524207	0.561246	0.598231
0.635135	0.671994	0.708733	0.745318	0.781847	0.818274	0.854511	0.890707
0.926678							
-0.059430	-0.064809	-0.069558	-0.073657	-0.077112	-0.079908	-0.082051	-0.083545
-0.084395	-0.084609	-0.084183	-0.083093	-0.081346	-0.078927	-0.075820	-0.072118
-0.067688	-0.062894	-0.057270	-0.050698	-0.043829	-0.036440	-0.028168	-0.019719
-0.010353							
AE-AE	7.7500	0.933396	0.015108	-0.069438	87.92320		
0.055076	0.054116	-0.010241	0.009004	0.924562	-0.001743		
0.064448	0.099814	0.135254	0.170767	0.206346	0.241986	0.277683	0.313432
0.349226	0.385060	0.420928	0.456826	0.492747	0.528687	0.564641	0.600602
0.636565	0.672526	0.708481	0.744421	0.780335	0.816220	0.852090	0.887939
0.923741							
0.043858	0.037325	0.031215	0.025539	0.020293	0.015483	0.011117	0.007192
0.003707	0.000660	-0.001953	-0.004124	-0.005865	-0.007162	-0.008007	-0.008420
-0.008412	-0.007988	-0.007180	-0.005883	-0.004003	-0.001633	0.000959	0.003828
0.007224							
0.045266	0.081946	0.118723	0.155586	0.192521	0.229517	0.266561	0.303639
0.340739	0.377847	0.414951	0.452038	0.489094	0.526106	0.563060	0.599945
0.636753	0.673479	0.710107	0.746600	0.782927	0.819105	0.855212	0.891182
0.926923							
-0.064602	-0.070221	-0.075171	-0.079429	-0.083007	-0.085896	-0.088083	-0.089570
-0.090378	-0.090513	-0.089959	-0.088705	-0.086744	-0.084068	-0.080691	-0.076631
-0.071920	-0.066604	-0.060654	-0.053926	-0.046350	-0.038092	-0.029531	-0.020413
-0.010432							

AF-AF	8.4310	0.933227	0.017050	-0.073327	88.66858		
0.059096	0.057947	-0.011593	0.009023	0.924399	-0.001866		
0.069672	0.104762	0.139933	0.175183	0.210507	0.245899	0.281356	0.316869
0.352433	0.388041	0.423689	0.459369	0.495076	0.530805	0.566548	0.602301
0.638056	0.673809	0.709555	0.745286	0.780990	0.816663	0.852320	0.887950
0.923524							
0.046328	0.039462	0.033019	0.027034	0.021492	0.016413	0.011797	0.007643
0.003948	0.000711	-0.002061	-0.004386	-0.006234	-0.007628	-0.008542	-0.008997
-0.009016	-0.008611	-0.007798	-0.006470	-0.004548	-0.002125	0.000526	0.003514
0.007114							
0.048037	0.084607	0.121287	0.158068	0.194926	0.231852	0.268829	0.305843
0.342879	0.379923	0.416960	0.453977	0.490957	0.527887	0.564751	0.601540
0.638241	0.674847	0.711337	0.747670	0.783812	0.819790	0.855696	0.891436
0.926915							
-0.069852	-0.075675	-0.080854	-0.085262	-0.088958	-0.091914	-0.094136	-0.095612
-0.096383	-0.096440	-0.095760	-0.094340	-0.092175	-0.089270	-0.085627	-0.081288
-0.076258	-0.070579	-0.064204	-0.056979	-0.048857	-0.040034	-0.030923	-0.021185
-0.010531							
AG-AG	9.1120	0.933944	0.019146	-0.077107	89.51190		
0.063011	0.061645	-0.013048	0.009029	0.925130	-0.001958		
0.074858	0.109706	0.144639	0.179670	0.214780	0.249966	0.285221	0.320540
0.355916	0.391340	0.426807	0.462311	0.497844	0.533400	0.568974	0.604557
0.640144	0.675729	0.711306	0.746866	0.782395	0.817892	0.853373	0.888825
0.924221							
0.048562	0.041352	0.034559	0.028291	0.022483	0.017155	0.012309	0.007952
0.004075	0.000677	-0.002239	-0.004678	-0.006635	-0.008109	-0.009096	-0.009604
-0.009650	-0.009266	-0.008439	-0.007046	-0.005017	-0.002484	0.000269	0.003360
0.007025							
0.050642	0.087101	0.123731	0.160479	0.197309	0.234213	0.271172	0.308170
0.345190	0.382218	0.419237	0.456231	0.493182	0.530073	0.566891	0.603622
0.640253	0.676779	0.713172	0.749382	0.785384	0.821210	0.856962	0.892519
0.927792							
-0.075091	-0.081143	-0.086545	-0.091089	-0.094910	-0.097933	-0.100187	-0.101676
-0.102420	-0.102404	-0.101615	-0.100038	-0.097658	-0.094483	-0.090543	-0.085864
-0.080461	-0.074388	-0.067561	-0.059827	-0.051171	-0.041813	-0.032173	-0.021846
-0.010585							
AH-AH	9.7930	0.945083	0.023153	-0.080523	94.57854		
0.067126	0.065231	-0.015839	0.009058	0.936314	-0.002269		
0.081153	0.116044	0.151042	0.186173	0.221405	0.256741	0.292167	0.327675
0.363255	0.398899	0.434597	0.470343	0.506126	0.541938	0.577769	0.613609
0.649451	0.685285	0.721105	0.756896	0.792640	0.828339	0.864015	0.899642
0.935186							
0.049372	0.041171	0.033443	0.026336	0.019752	0.013752	0.008308	0.003430
-0.000895	-0.004663	-0.007864	-0.010492	-0.012540	-0.014004	-0.014884	-0.015210
-0.014991	-0.014264	-0.013013	-0.011101	-0.008458	-0.005255	-0.001801	0.002110
0.006718							
0.051840	0.088750	0.125810	0.163010	0.200324	0.237734	0.275221	0.312760
0.350330	0.387913	0.425488	0.463032	0.500524	0.537943	0.575271	0.612490
0.649584	0.686546	0.723325	0.759867	0.796151	0.832234	0.868228	0.903938
0.939288							
-0.081616	-0.088674	-0.094920	-0.100272	-0.104769	-0.108363	-0.111058	-0.112888
-0.113882	-0.113999	-0.113217	-0.111513	-0.108892	-0.105382	-0.101009	-0.095788
-0.089748	-0.082937	-0.075207	-0.066423	-0.056629	-0.046113	-0.035299	-0.023585
-0.010825							
AJ-AJ	10.0000	0.959543	0.026222	-0.080849	99.13867		
0.063333	0.065910	-0.018035	0.009020	0.950882	-0.002520		
0.083884	0.119092	0.154440	0.189956	0.225601	0.261379	0.297275	0.333275
0.369363	0.405531	0.441767	0.478060	0.514398	0.550768	0.587157	0.623553
0.659944	0.696320	0.732670	0.768971	0.805201	0.841365	0.877498	0.913558
0.949499							

0.047892	0.038670	0.030001	0.022045	0.014692	0.008018	0.002004	-0.003350
-0.008068	-0.012135	-0.015540	-0.018274	-0.020325	-0.021694	-0.022380	-0.022418
-0.021829	-0.020646	-0.018816	-0.016199	-0.012736	-0.008634	-0.004261	0.000663
0.006394							
0.050517	0.088018	0.125703	0.163566	0.201577	0.239716	0.277954	0.316261
0.354613	0.392988	0.431358	0.469698	0.507978	0.546178	0.584273	0.622242
0.660064	0.697720	0.735144	0.772274	0.809102	0.845709	0.882214	0.918347
0.954061							
-0.084612	-0.092761	-0.100011	-0.106270	-0.111547	-0.115812	-0.119071	-0.121373
-0.122732	-0.123099	-0.122455	-0.120773	-0.118059	-0.114381	-0.109751	-0.104167
-0.097672	-0.090268	-0.081775	-0.072079	-0.061289	-0.049767	-0.037925	-0.025005
-0.010961							

CA135300.N236340

TITLE

CASE-EXIT GUIDE VANE CATEGORY 1 P/N4060684 NO REV EMD4060684 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830823	R.L.SANFORD	830823

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
31154B			237442	1	4060684 NO REV	4060684 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

CASE-EXIT GUIDE VANE (ID) CAT 1 P/N4060684 NO REV EMD4060684 NO REV

9	50	3	0				
A-A	* 5.0750	1.996845	0.095421	1.094944	63.91212		
0.005857	0.005748	0.001129	0.009054	1.988166	0.002584		
0.004546	0.045090	0.085635	0.126179	0.166723	0.207268	0.247812	0.288357
0.328901	0.369446	0.409990	0.450535	0.491079	0.531624	0.572168	0.612712
0.653257	0.693801	0.734346	0.774890	0.815435	0.855979	0.896524	0.937068
0.977612	1.018156	1.058700	1.099243	1.139787	1.180330	1.220874	1.261417
1.301961	1.342505	1.383048	1.423592	1.464135	1.504679	1.545222	1.585766
1.626309	1.666853	1.707397	1.747940	1.788484	1.829027	1.869571	1.910114
1.950658	1.991226						
0.006862	0.015351	0.023921	0.032468	0.040976	0.049367	0.057630	0.065752
0.073720	0.081543	0.088958	0.096114	0.103097	0.109829	0.116230	0.122230
0.127905	0.133259	0.138252	0.142842	0.147003	0.150829	0.154276	0.157258
0.159694	0.161530	0.162872	0.163688	0.163917	0.163499	0.162396	0.160665
0.158300	0.155285	0.151603	0.147256	0.142267	0.136610	0.130255	0.123172
0.115334	0.106748	0.097440	0.087436	0.076761	0.065230	0.052712	0.039490
0.025849	0.011106						
0.006579	0.046983	0.087388	0.127792	0.168196	0.208601	0.249005	0.289410
0.329814	0.370219	0.410623	0.451028	0.491432	0.531836	0.572241	0.612645
0.653050	0.693454	0.733859	0.774263	0.814667	0.855072	0.895476	0.935881
0.976285	1.016689	1.057094	1.097498	1.137902	1.178307	1.218711	1.259115
1.299520	1.339924	1.380328	1.420732	1.461137	1.501541	1.541945	1.582350
1.622754	1.663158	1.703563	1.743967	1.784371	1.824776	1.865180	1.905584
1.945989	1.986400						
-0.004669	0.001111	0.006967	0.012782	0.018543	0.024203	0.029750	0.035181
0.040507	0.045730	0.050585	0.055207	0.059676	0.063914	0.067841	0.071387
0.074620	0.077548	0.080141	0.082366	0.084193	0.085625	0.086685	0.087398
0.087787	0.087865	0.087598	0.087001	0.086101	0.084926	0.083499	0.081816
0.079852	0.077580	0.074975	0.072029	0.068770	0.065184	0.061256	0.056969
0.052314	0.047301	0.041936	0.036221	0.030161	0.023662	0.016667	0.009323
0.001776	-0.006297						

* This dimension is the radial distance from the rig centerline to the airfoil manufacturing cross section. For further definition, see drawing T4060684 Sheet 1.

B-B	5.2130	1.996823	0.069943	1.094845	65.88576		
0.005914	0.005848	0.000879	0.008995	1.988032	0.001912		
0.004862	0.045385	0.085909	0.126433	0.166957	0.207480	0.248004	0.288528
0.329052	0.369576	0.410099	0.450623	0.491147	0.531671	0.572194	0.612718
0.653242	0.693766	0.734289	0.774813	0.815337	0.855861	0.896384	0.936908
0.977432	1.017956	1.058479	1.099003	1.139526	1.180050	1.220573	1.261097
1.301620	1.342144	1.382668	1.423191	1.463715	1.504238	1.544762	1.585285
1.625809	1.666332	1.706856	1.747379	1.787903	1.828426	1.868950	1.909473
1.949997	1.990527						
0.006710	0.013573	0.020424	0.027179	0.033859	0.040400	0.046778	0.053006
0.059096	0.065048	0.070710	0.076194	0.081556	0.086737	0.091681	0.096337
0.100754	0.104939	0.108868	0.112516	0.115873	0.119017	0.121901	0.124444
0.126567	0.128220	0.129506	0.130393	0.130814	0.130706	0.130029	0.128849
0.127153	0.124924	0.122140	0.118795	0.114914	0.110481	0.105479	0.099891
0.093703	0.086920	0.079555	0.071620	0.063127	0.053925	0.043916	0.033328
0.022393	0.010553						
0.006453	0.046871	0.087288	0.127706	0.168123	0.208541	0.248959	0.289376
0.329794	0.370211	0.410629	0.451047	0.491464	0.531882	0.572299	0.612717
0.653135	0.693552	0.733970	0.774388	0.814805	0.855223	0.895640	0.936058
0.976476	1.016892	1.057309	1.097726	1.138143	1.178559	1.218976	1.259393
1.299809	1.340226	1.380643	1.421060	1.461476	1.501893	1.542310	1.582726
1.623143	1.663560	1.703977	1.744393	1.784810	1.825227	1.865644	1.906060
1.946477	1.986918						
-0.005004	-0.000831	0.003267	0.007249	0.011145	0.014943	0.018652	0.022242
0.025679	0.028974	0.032011	0.034890	0.037659	0.040269	0.042673	0.044830
0.046791	0.048553	0.050086	0.051356	0.052332	0.053003	0.053403	0.053573
0.053555	0.053376	0.052990	0.052406	0.051648	0.050739	0.049698	0.048518
0.047181	0.045672	0.043975	0.042089	0.040039	0.037803	0.035360	0.032684
0.029767	0.026626	0.023264	0.019681	0.015879	0.011799	0.007407	0.002795
-0.001944	-0.007014						
C-C	5.3510	1.996613	0.057376	1.094889	67.26488		
0.005934	0.005875	0.000837	0.008955	1.987775	0.001456		
0.004887	0.045396	0.085906	0.126416	0.166926	0.207435	0.247945	0.288455
0.328965	0.369475	0.409984	0.450494	0.491004	0.531514	0.572023	0.612533
0.653043	0.693553	0.734062	0.774572	0.815082	0.855592	0.896101	0.936611
0.977121	1.017631	1.058140	1.098649	1.139158	1.179667	1.220177	1.260686
1.301195	1.341704	1.382214	1.422723	1.463232	1.503741	1.544250	1.584760
1.625269	1.665778	1.706287	1.746797	1.787306	1.827815	1.868324	1.908834
1.949343	1.989867						
0.006689	0.013560	0.020300	0.026806	0.033150	0.039273	0.045143	0.050789
0.056247	0.061510	0.066408	0.071050	0.075519	0.079787	0.083828	0.087615
0.091167	0.094491	0.097583	0.100440	0.103065	0.105515	0.107746	0.109690
0.111281	0.112478	0.113370	0.113927	0.114090	0.113803	0.113032	0.111826
0.110184	0.108093	0.105542	0.102529	0.099067	0.095146	0.090756	0.085885
0.080521	0.074663	0.068329	0.061536	0.054301	0.046502	0.038056	0.029157
0.019999	0.010163						
0.006458	0.046879	0.087301	0.127723	0.168144	0.208566	0.248987	0.289409
0.329831	0.370252	0.410674	0.451095	0.491517	0.531939	0.572360	0.612782
0.653203	0.693625	0.734047	0.774468	0.814890	0.855312	0.895733	0.936155
0.976576	1.016997	1.057419	1.097840	1.138262	1.178683	1.219105	1.259526
1.299948	1.340369	1.380791	1.421212	1.461634	1.502055	1.542477	1.582898
1.623320	1.663741	1.704163	1.744584	1.785006	1.825427	1.865849	1.906270
1.946692	1.987119						
-0.005068	-0.001046	0.002854	0.006555	0.010113	0.013470	0.016595	0.019519
0.022284	0.024881	0.027147	0.029185	0.031067	0.032766	0.034251	0.035496
0.036515	0.037321	0.037910	0.038285	0.038437	0.038323	0.037981	0.037466
0.036833	0.036117	0.035247	0.034246	0.033153	0.032010	0.030846	0.029640
0.028374	0.027033	0.025604	0.024080	0.022475	0.020786	0.019007	0.017133
0.015166	0.013114	0.010967	0.008715	0.006345	0.003822	0.001137	-0.001653
-0.004495	-0.007475						

D-D	5.4430	1.996677	0.056545	1.095582	67.63075		
0.005981	0.005918	0.000868	0.009016	1.987771	0.001414		
0.004903	0.045412	0.085920	0.126428	0.166936	0.207445	0.247953	0.288461
0.328970	0.369478	0.409986	0.450494	0.491003	0.531511	0.572019	0.612527
0.653036	0.693544	0.734052	0.774561	0.815069	0.855577	0.896085	0.936594
0.977102	1.017610	1.058118	1.098626	1.139134	1.179643	1.220151	1.260659
1.301167	1.341676	1.382184	1.422692	1.463201	1.503709	1.544217	1.584725
1.625234	1.665742	1.706250	1.746758	1.787267	1.827775	1.868283	1.908792
1.949300	1.989812						
0.006762	0.013768	0.020621	0.027213	0.033629	0.039813	0.045737	0.051420
0.056875	0.062101	0.066976	0.071623	0.076109	0.080395	0.084444	0.088219
0.091745	0.095034	0.098078	0.100876	0.103428	0.105787	0.107913	0.109745
0.111223	0.112308	0.113085	0.113522	0.113567	0.113165	0.112282	0.110963
0.109210	0.107017	0.104379	0.101295	0.097771	0.093802	0.089380	0.084499
0.079143	0.073307	0.067016	0.060294	0.053167	0.045518	0.037267	0.028599
0.019700	0.010195						
0.006529	0.046951	0.087373	0.127795	0.168217	0.208639	0.249061	0.289483
0.329905	0.370327	0.410748	0.451170	0.491592	0.532014	0.572436	0.612858
0.653280	0.693702	0.734124	0.774546	0.814968	0.855390	0.895812	0.936234
0.976656	1.017077	1.057499	1.097920	1.138342	1.178763	1.219185	1.259606
1.300028	1.340449	1.380871	1.421292	1.461714	1.502135	1.542557	1.582978
1.623400	1.663821	1.704243	1.744664	1.785086	1.825507	1.865929	1.906350
1.946772	1.987206						
-0.005082	-0.000881	0.003112	0.006837	0.010375	0.013718	0.016860	0.019796
0.022526	0.025052	0.027258	0.029259	0.031114	0.032786	0.034236	0.035429
0.036388	0.037124	0.037635	0.037918	0.037965	0.037721	0.037229	0.036555
0.035762	0.034894	0.033872	0.032716	0.031472	0.030183	0.028878	0.027524
0.026114	0.024648	0.023125	0.021545	0.019913	0.018223	0.016469	0.014643
0.012741	0.010770	0.008730	0.006623	0.004449	0.002190	-0.000165	-0.002585
-0.005039	-0.007584						
E-E	5.5350	1.996035	0.055943	1.095613	67.74434		
0.006016	0.005947	0.000908	0.008957	1.987175	0.001332		
0.004886	0.045382	0.085878	0.126374	0.166870	0.207366	0.247861	0.288357
0.328853	0.369349	0.409845	0.450340	0.490836	0.531332	0.571828	0.612324
0.652819	0.693315	0.733811	0.774307	0.814803	0.855299	0.895794	0.936290
0.976786	1.017282	1.057776	1.098271	1.138766	1.179261	1.219756	1.260251
1.300746	1.341241	1.381736	1.422231	1.462726	1.503221	1.543715	1.584210
1.624705	1.665200	1.705695	1.746190	1.786685	1.827180	1.867675	1.908170
1.948665	1.989182						
0.006830	0.014131	0.021198	0.027923	0.034424	0.040679	0.046683	0.052423
0.057882	0.063066	0.067883	0.072464	0.076875	0.081080	0.085041	0.088725
0.092147	0.095323	0.098257	0.100954	0.103426	0.105726	0.107804	0.109594
0.111025	0.112054	0.112767	0.113139	0.113119	0.112656	0.111719	0.110347
0.108545	0.106309	0.103637	0.100528	0.096988	0.093010	0.088589	0.083717
0.078380	0.072573	0.066319	0.059644	0.052575	0.045000	0.036840	0.028270
0.019469	0.010062						
0.006587	0.046997	0.087407	0.127817	0.168227	0.208637	0.249047	0.289457
0.329867	0.370277	0.410687	0.451097	0.491507	0.531917	0.572327	0.612737
0.653147	0.693557	0.733967	0.774377	0.814787	0.855197	0.895607	0.936017
0.976427	1.016836	1.057245	1.097654	1.138063	1.178473	1.218882	1.259291
1.299700	1.340109	1.380518	1.420927	1.461336	1.501745	1.542154	1.582563
1.622972	1.663382	1.703791	1.744200	1.784609	1.825018	1.865427	1.905836
1.946245	1.986677						
-0.005073	-0.000700	0.003473	0.007361	0.011048	0.014479	0.017617	0.020501
0.023178	0.025637	0.027755	0.029649	0.031386	0.032931	0.034251	0.035315
0.036136	0.036729	0.037098	0.037247	0.037175	0.036830	0.036249	0.035489
0.034606	0.033636	0.032495	0.031217	0.029857	0.028470	0.027097	0.025694
0.024253	0.022768	0.021234	0.019650	0.018020	0.016343	0.014618	0.012844
0.011020	0.009146	0.007223	0.005255	0.003241	0.001167	-0.000973	-0.003157
-0.005358	-0.007612						

F-F	5.6260	1.995916	0.060053	1.095870	67.55272		
0.006022	0.005935	0.001019	0.009003	1.987021	0.001406		
0.004739	0.045236	0.085733	0.126230	0.166727	0.207224	0.247720	0.288217
0.328714	0.369211	0.409708	0.450205	0.490701	0.531198	0.571695	0.612192
0.652689	0.693186	0.733682	0.774179	0.814676	0.855173	0.895670	0.936166
0.976663	1.017159	1.057656	1.098153	1.138650	1.179147	1.219644	1.260140
1.300637	1.341134	1.381631	1.422128	1.462625	1.503121	1.543618	1.584115
1.624612	1.665109	1.705606	1.746102	1.786599	1.827096	1.867593	1.908090
1.948586	1.989084						
0.006921	0.015190	0.023170	0.030692	0.037904	0.044773	0.051269	0.057421
0.063260	0.068781	0.073865	0.078666	0.083262	0.087616	0.091690	0.095447
0.098895	0.102057	0.104946	0.107577	0.109968	0.112158	0.114104	0.115745
0.117020	0.117893	0.118443	0.118644	0.118443	0.117789	0.116648	0.115060
0.113030	0.110558	0.107640	0.104275	0.100462	0.096203	0.091499	0.086352
0.080751	0.074684	0.068174	0.061244	0.053919	0.046085	0.037661	0.028834
0.019788	0.010170						
0.006705	0.047109	0.087513	0.127917	0.168320	0.208724	0.249128	0.289532
0.329936	0.370339	0.410743	0.451147	0.491551	0.531954	0.572358	0.612762
0.653166	0.693570	0.733973	0.774377	0.814781	0.855185	0.895589	0.935992
0.976396	1.016799	1.057202	1.097606	1.138009	1.178412	1.218816	1.259219
1.299623	1.340026	1.380429	1.420833	1.461236	1.501639	1.542043	1.582446
1.622849	1.663253	1.703656	1.744060	1.784463	1.824866	1.865270	1.905673
1.946076	1.986493						
-0.004954	0.000325	0.005306	0.009884	0.014179	0.018162	0.021805	0.025135
0.028190	0.030962	0.033312	0.035378	0.037244	0.038880	0.040257	0.041348
0.042161	0.042711	0.043006	0.043056	0.042860	0.042358	0.041593	0.040635
0.039551	0.038386	0.037051	0.035575	0.034009	0.032406	0.030797	0.029139
0.027430	0.025679	0.023893	0.022077	0.020228	0.018341	0.016412	0.014438
0.012414	0.010341	0.008225	0.006073	0.003892	0.001674	-0.000589	-0.002886
-0.005206	-0.007582						
G-G	5.7180	1.994261	0.070790	1.095714	66.71779		
0.006133	0.005990	0.001317	0.009053	1.985345	0.001580		
0.004502	0.044973	0.085443	0.125914	0.166385	0.206856	0.247327	0.287798
0.328269	0.368740	0.409211	0.449682	0.490153	0.530624	0.571095	0.611566
0.652037	0.692508	0.732979	0.773450	0.813921	0.854392	0.894863	0.935334
0.975805	1.016275	1.056746	1.097216	1.137686	1.178156	1.218626	1.259096
1.299566	1.340036	1.380507	1.420977	1.461447	1.501917	1.542387	1.582857
1.623327	1.663797	1.704268	1.744738	1.785208	1.825678	1.866148	1.906618
1.947088	1.987580						
0.007266	0.017494	0.027248	0.036328	0.044966	0.053137	0.060810	0.068021
0.074818	0.081193	0.086971	0.092343	0.097429	0.102196	0.106611	0.110645
0.114294	0.117584	0.120538	0.123178	0.125532	0.127625	0.129417	0.130856
0.131891	0.132489	0.132721	0.132563	0.131969	0.130896	0.129312	0.127249
0.124716	0.121716	0.118255	0.114334	0.109946	0.105094	0.099775	0.093991
0.087730	0.080977	0.073759	0.066104	0.058039	0.049441	0.040225	0.030595
0.020755	0.010353						
0.007055	0.047415	0.087774	0.128134	0.168493	0.208853	0.249212	0.289572
0.329931	0.370291	0.410650	0.451010	0.491369	0.531729	0.572088	0.612448
0.652807	0.693167	0.733526	0.773886	0.814245	0.854605	0.894964	0.935324
0.975683	1.016042	1.056401	1.096761	1.137120	1.177480	1.217839	1.258199
1.298558	1.338918	1.379277	1.419637	1.459996	1.500356	1.540715	1.581075
1.621434	1.661794	1.702153	1.742513	1.782872	1.823232	1.863591	1.903951
1.944310	1.984672						
-0.004723	0.002509	0.009220	0.015334	0.021054	0.026327	0.031112	0.035450
0.039388	0.042917	0.045898	0.048517	0.050876	0.052936	0.054658	0.056005
0.056978	0.057603	0.057905	0.057908	0.057625	0.056978	0.056013	0.054806
0.053433	0.051939	0.050220	0.048316	0.046294	0.044221	0.042143	0.040001
0.037792	0.035524	0.033203	0.030831	0.028401	0.025916	0.023380	0.020797
0.018165	0.015479	0.012745	0.009972	0.007169	0.004328	0.001439	-0.001487
-0.004437	-0.007449						

H-H	5.8560	1.991628	0.100350	1.094974	64.10526		
0.006170	0.005855	0.001948	0.009095	1.982759	0.002024		
0.003752	0.044196	0.084641	0.125085	0.165529	0.205973	0.246418	0.286862
0.327306	0.367750	0.408195	0.448639	0.489083	0.529527	0.569972	0.610416
0.650860	0.691305	0.731749	0.772193	0.812637	0.853082	0.893526	0.933970
0.974414	1.014858	1.055302	1.095745	1.136189	1.176632	1.217075	1.257519
1.297962	1.338406	1.378849	1.419292	1.459736	1.500179	1.540623	1.581066
1.621510	1.661953	1.702396	1.742840	1.783283	1.823727	1.864170	1.904613
1.945057	1.985523						
0.007749	0.022543	0.036783	0.049983	0.062453	0.074079	0.084761	0.094627
0.103813	0.112294	0.119841	0.126753	0.133212	0.139183	0.144630	0.149518
0.153829	0.157603	0.160885	0.163724	0.166162	0.168196	0.169794	0.170923
0.171551	0.171660	0.171308	0.170467	0.169094	0.167146	0.164591	0.161453
0.157746	0.153484	0.148680	0.143338	0.137445	0.130999	0.124005	0.116462
0.108353	0.099659	0.090415	0.080660	0.070434	0.059599	0.048051	0.036011
0.023704	0.010689						
0.007540	0.047826	0.088113	0.128399	0.168686	0.208973	0.249259	0.289546
0.329832	0.370119	0.410406	0.450692	0.490979	0.531265	0.571552	0.611839
0.652125	0.692412	0.732698	0.772985	0.813272	0.853558	0.893845	0.934131
0.974418	1.014704	1.054990	1.095276	1.135562	1.175848	1.216134	1.256420
1.296706	1.336992	1.377278	1.417564	1.457850	1.498137	1.538423	1.578709
1.618995	1.659281	1.699567	1.739853	1.780139	1.820425	1.860711	1.900997
1.941283	1.981586						
-0.003988	0.007573	0.018626	0.028754	0.038193	0.046818	0.054517	0.061435
0.067731	0.073371	0.078110	0.082230	0.085912	0.089120	0.091820	0.093976
0.095570	0.096640	0.097230	0.097388	0.097140	0.096385	0.095173	0.093598
0.091753	0.089696	0.087298	0.084607	0.081703	0.078668	0.075552	0.072282
0.068860	0.065302	0.061621	0.057822	0.053887	0.049824	0.045647	0.041365
0.036976	0.032466	0.027849	0.023141	0.018356	0.013472	0.008467	0.003380
-0.001751	-0.006996						
J-J	5.9950	1.984586	0.130141	1.090074	61.82303		
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0.326169	0.366490	0.406812	0.447133	0.487455	0.527776	0.568098	0.608419
0.648741	0.689062	0.729384	0.769705	0.810027	0.850348	0.890670	0.930991
0.971312	1.011634	1.051955	1.092277	1.132598	1.172919	1.213241	1.253562
1.293883	1.334205	1.374526	1.414847	1.455169	1.495490	1.535811	1.576133
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1.939025	1.979350						
0.008850	0.026363	0.043018	0.058510	0.073267	0.087179	0.100172	0.112331
0.123750	0.134419	0.144006	0.152870	0.161224	0.168999	0.176121	0.182523
0.188216	0.193248	0.197656	0.201478	0.204752	0.207487	0.209646	0.211193
0.212088	0.212310	0.211914	0.210878	0.209166	0.206739	0.203566	0.199663
0.195049	0.189741	0.183758	0.177107	0.169766	0.161734	0.153013	0.143601
0.133472	0.122598	0.111030	0.098817	0.086013	0.072442	0.057967	0.042869
0.027433	0.011105						
0.008560	0.048676	0.088791	0.128906	0.169022	0.209137	0.249252	0.289368
0.329483	0.369598	0.409714	0.449829	0.489944	0.530060	0.570175	0.610291
0.650406	0.690521	0.730637	0.770752	0.810867	0.850983	0.891098	0.931213
0.971329	1.011444	1.051559	1.091675	1.131790	1.171906	1.212021	1.252136
1.292252	1.332367	1.372482	1.412598	1.452713	1.492828	1.532944	1.573059
1.613174	1.653290	1.693405	1.733521	1.773636	1.813751	1.853867	1.893982
1.934097	1.974213						
-0.003803	0.010666	0.024167	0.036594	0.048325	0.059220	0.069181	0.078326
0.086796	0.094566	0.101280	0.107273	0.112762	0.117688	0.121994	0.125623
0.128596	0.130944	0.132681	0.133823	0.134371	0.134228	0.133465	0.132194
0.130527	0.128537	0.126093	0.123227	0.120009	0.116508	0.112763	0.108703
0.104341	0.099705	0.094821	0.089699	0.084307	0.078658	0.072772	0.066665
0.060332	0.053748	0.046941	0.039937	0.032765	0.025371	0.017708	0.009876
0.001977	-0.006105						

CA135400.N236344

TITLE

FLAP-EXIT GUIDE VANE CATEGORY 1 P/N4060686 NO REV EMD4060686 NO REV *

ENGINEER'S NAME	CHECKED BY	DATE	APPROVED BY	DATE
S.SALVAGGIO	R.L.WALLS	830823	R.L.SANFORD	830825

DES JOB NO	TD NO	REV	L/O	SH	PART NO	AIRFOIL EMD	CLAB
31154B			237442	1	4060686 NO REV	4060686 NO REV	1

ASSOCIATED PART NUMBERS

ASSOCIATED EMD NUMBERS

ASSOCIATED COMPUTER FILES

FLAP-EXIT GUIDE VANE (OD) CAT 1 P/N4060686 NO REV EMD4060686 NO REV

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0.032779							
0.004018	0.046269	0.088712	0.131489	0.174488	0.217708	0.261164	0.304822
0.348649	0.392617	0.436754	0.480986	0.525265	0.569586	0.613935	0.658287
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-0.055001							
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0.348275	0.391179	0.434103	0.477028	0.519947	0.562851	0.605725	0.648554
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1.030180							
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0.004120	0.046369	0.088795	0.131525	0.174460	0.217603	0.260966	0.304515
0.348219	0.392054	0.436052	0.480139	0.524272	0.568448	0.612652	0.656861

* For definition of this dimension, see drawing T4060686.

0.701049	0.745192	0.789267	0.833250	0.877116	0.920839	0.964398	1.007771
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-0.103856	-0.101417	-0.097951	-0.093465	-0.087953	-0.081403	-0.073838	-0.065273
-0.055723							
C-C	3.7670	1.083549	-0.010467	1.037067	64.45766		
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0.006713	0.049093	0.091532	0.134050	0.176619	0.219239	0.261906	0.304610
0.347339	0.390087	0.432846	0.475604	0.518354	0.561089	0.603795	0.646461
0.689079	0.731641	0.774135	0.816553	0.858886	0.901122	0.943252	0.985267
1.027158							
0.004715	-0.000967	-0.006191	-0.010732	-0.014772	-0.018213	-0.021029	-0.023216
-0.024841	-0.025825	-0.025903	-0.025446	-0.024548	-0.023089	-0.020960	-0.018129
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0.004211	0.046388	0.088724	0.131341	0.174145	0.217147	0.260353	0.303730
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-0.101267	-0.099089	-0.095948	-0.091858	-0.086801	-0.080783	-0.073806	-0.065887
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D-D	3.0860	1.088389	-0.011241	1.037717	63.23354		
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0.006716	0.049115	0.091572	0.134104	0.176683	0.219314	0.261991	0.304701
0.347432	0.390179	0.432932	0.475680	0.518418	0.561139	0.603830	0.646478
0.689077	0.731618	0.774095	0.816499	0.858820	0.901052	0.943183	0.985209
1.027123							
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0.004177	0.046299	0.088590	0.131183	0.173982	0.216993	0.260230	0.303652
0.347221	0.390916	0.434774	0.478719	0.522712	0.566750	0.610820	0.654902
0.698970	0.743002	0.786978	0.830879	0.874681	0.918366	0.961910	1.005298
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-0.062010							
E-E	2.4050	1.097693	-0.013005	1.043159	62.04858		
0.006143	0.005970	-0.001447	0.056062	1.043159	-0.013004		
0.006805	0.049327	0.091928	0.134618	0.177363	0.220165	0.263020	0.305912
0.348830	0.391766	0.434710	0.477648	0.520575	0.563482	0.606354	0.649178
0.691947	0.734652	0.777282	0.819827	0.862277	0.904620	0.946848	0.988955
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0.703366	0.747791	0.792150	0.836423	0.880581	0.924599	0.968456	1.012136
1.055614							
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APPENDIX D
DEFINITION OF SYMBOLS

AR	Aspect ratio, H/b
A^1	Point midway between leading edge and first captured Mach wave emanation point on suction surface
A/A*	Critical area ratio
a	Acoustic velocity, m/s or ft/s
BPR	Bypass ratio
b	Chord, centimeters or inches
CAIJO	Ratio of front camber-to-chord/total camber-to-chord
C_{L_o}	Lift coefficient for 63 series airfoil
D_F	Diffusion factor $= 1 - \frac{V_{i+1}}{V_i} + \frac{r_{i+1}(V\theta_{i+1}) - r_i(V\theta_i)}{(r_i + r_{i+1})V_i\sigma}$
E	Excitation per rotor revolution
H	Average blade height, cm or in.
ID	Inner diameter, cm or in.
i, inc	Incidence = angle between inlet air direction and tangent to blade reference station, degrees
LER	Leading edge radius, cm or in.
LMT	Location of maximum thickness, % of chord
M	Mach number
MCA	Multiple circular arc
N	Rotor speed, radians/s or rpm
OD	Outer diameter, cm or in.
P	Pressure, n/cm^2 or psia
r	Radius, cm or in.
SM	Stall margin, %
T	Temperature, °R or °F
t	Maximum blade thickness, cm or in.

t/b	Maximum thickness-to-chord ratio
TER	Trailing edge radius, cm or in.
U	Rotor wheel velocity, m/s or ft/s
V	Air velocity, m/s or ft/s
W	Mass flowrate, kg/s or lbm/s
Z	Loss coefficient; axial direction
α	Air angle, angle between absolute velocity vector and axial direction, degrees
β	Air angle, angle between relative velocity vector and axial direction, degrees
γ	Ratio of specific heats
Δ	Difference
δ	Ratio of total pressure to NASA standard sea level pressure of 10.1315 N/cm^2 (14.694 psia)
δ°	Deviation angle, degrees
η	Efficiency, %
$-\!\wedge\!-$	Hub-to-tip ratio
θ	Ratio of total temperature to NASA standard sea level temperature of 518.7°R; turning angle, degrees
θ^*	Camber angle, degrees
ρ	Density, kg/m^3 or lbm/ft^3
ϕ	Meridional flow angle, angle between axial velocity vector and centerline, degrees
σ	Solidity, ratio of chord to spacing; stress, kg/cm^2 or $lbf/in.^2$
τ	Blade spacing, cm or in.
ω	Total pressure loss coefficient

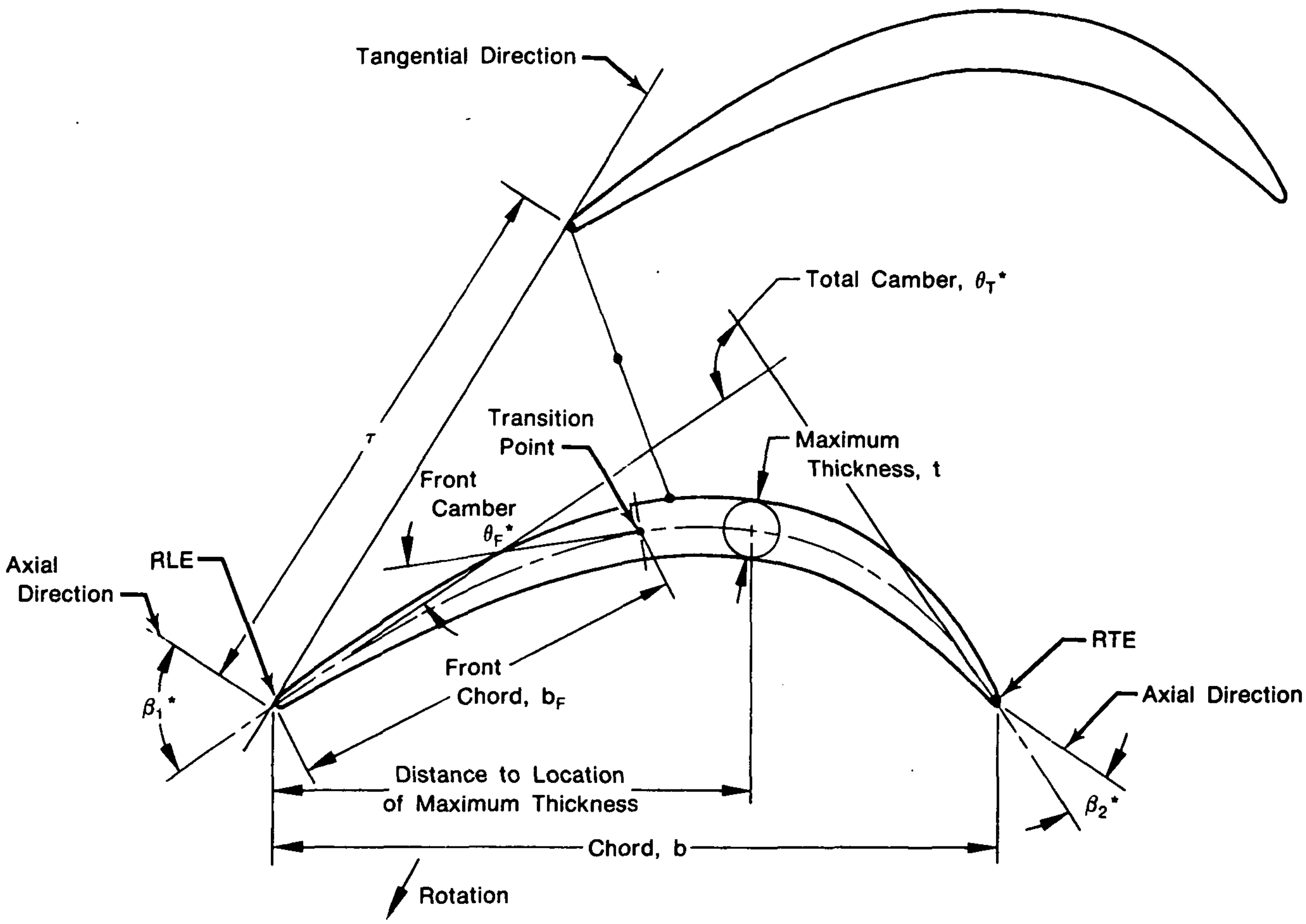

Figure 91. Multiple Circular Arc Airfoil Definitions

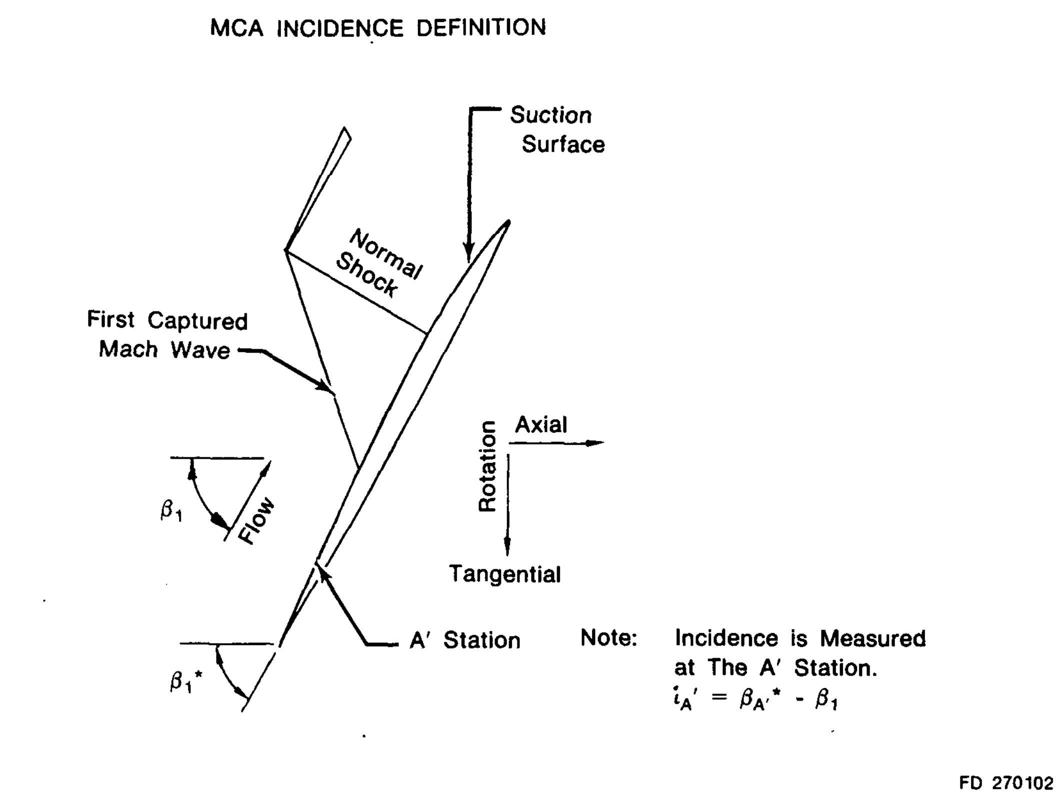

Figure 92. Multiple Circular Arc Incidence Definitions

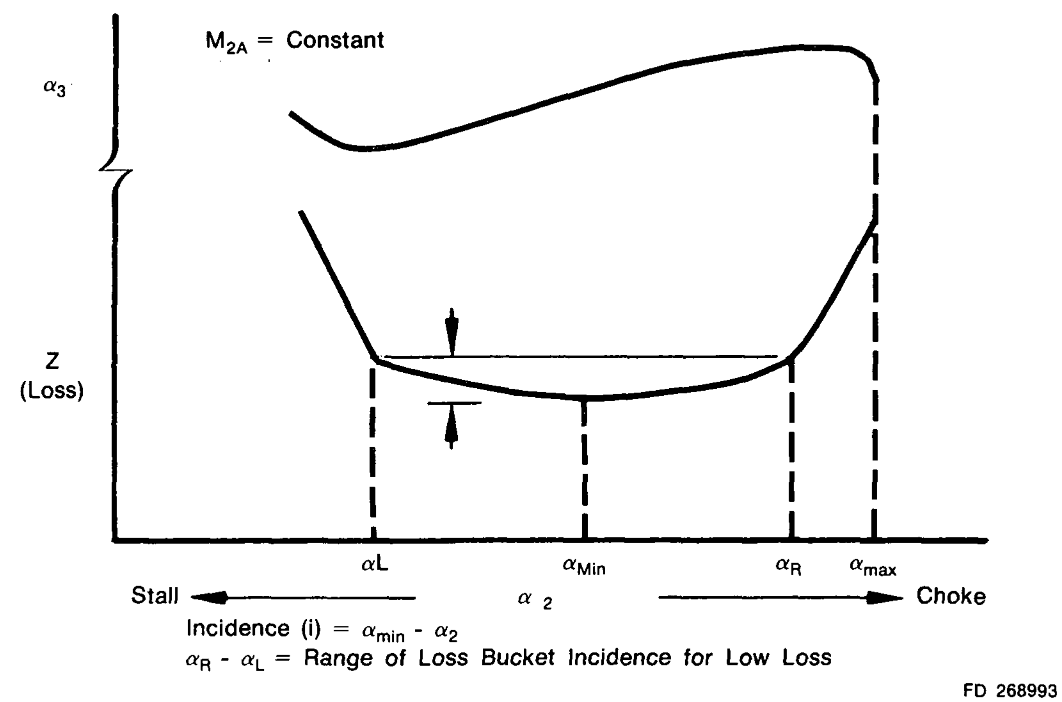

Figure 93. Cascade Loss Bucket Definitions

Subscripts

ad	Adiabatic
CH	Chord
F	Front
L	Left, stall limit of cascade loss bucket
LE	Leading edge
M	Meridional
O	Stagnation values
R	Right, choke limit of cascade loss bucket
S	Static
SS	Suction surface
T	Total
TE	Trailing edge
θ	Tangential direction
1	Rotor inlet station
2	Stator inlet station
3	Stator exit station

Superscript

*	Metal geometry
—	Mean value
′	Relative to rotor

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APPENDIX E
DEFINITION OF VARIABLES

Absolute Mach number:

$$M = \sqrt{\frac{2}{\gamma - 1}\left[\left(\frac{P_s}{P_t}\right)^{\frac{1-\gamma}{\gamma}} - 1\right]}$$

Static Temperature:

$$T_s = \frac{T_t}{1 + \frac{\gamma - 1}{2} M^2}$$

Acoustic Velocity:

$$a = \sqrt{\gamma g R T_s}$$

Absolute Velocity:

$$V = Ma$$

Axial Component of Absolute Velocity:

$$V_Z = \frac{V}{\sqrt{\sec^2\phi + \tan^2\beta}}$$

Meridional Component of Absolute Velocity:

$$V_m = V_Z \sec\phi$$

Tangential Component of Absolute Velocity:

$$V_\theta = V_Z \tan\beta$$

Radial Component of Absolute Velocity:

$$V_r = V_Z \tan\phi$$

Absolute Air Angle (meridional plane):

$$\overline{\beta} = \tan^{-1}\left(\frac{V_\theta}{V_m}\right)$$

Wheel Speed:

$$U = \omega r = \frac{\Pi N D}{\text{constant}}$$

Tangential Component of Relative Velocity:

$$V_\theta' = U - V_\theta$$

Relative Air Angle:

$$\beta' = \tan^{-1} \frac{V_\theta'}{V_z} \quad \text{(axial plane)}$$

$$\beta' = \tan^{-1} \frac{V_\theta'}{V_m} \quad \text{(meridional plane)}$$

Relative Velocity:

$$V' = V_m \sec\overline{\beta}'$$

Relative Mach Number:

$$M' = M \frac{\cos\overline{\beta}}{\cos\overline{\beta}'}$$

Relative Total Pressure:

$$P_t' = P_S\left[1 + \frac{\gamma - 1}{2} (M')^2\right]^{\gamma/\gamma-1}$$

Relative Total Temperature:

$$T_t' = T_S\left[1 + \frac{\gamma - 1}{2} (M')^2\right]$$

Pressure Ratio:

$$PR = \frac{\text{exit } P_t}{\text{inlet } P_t}$$

Turning:

$$\theta' = \text{inlet } \overline{\beta}' - \text{exit } \overline{\beta}' \quad \text{(rotor)}$$

$$\theta' = \text{inlet } \overline{\beta} - \text{exit } \overline{\beta} \quad \text{(stator)}$$

Loading Parameter:

$$\frac{\Delta P}{P_o - P} = (P_{s_{exit}} - P_{s_{inlet}}) \,/\, (P_{o_{inlet}} - P_{s_{inlet}})$$

Loss Coefficient:

$$\bar{\omega}' = \frac{\text{exit ideal} P_t' - \text{exit } P_t'}{\text{inlet } P_t' - \text{inlet } P_S} \quad \text{(rotor)}$$

$$\bar{\omega} = \frac{\text{inlet } P_t - \text{exit } P_t}{\text{inlet } P_t - \text{inlet } P_S} \quad \text{(stator)}$$

where:

$$\text{ideal } P_t' = \text{inlet } P_t' \left| 1 + \frac{\gamma - 1}{2} \frac{\text{exit } U^2}{\gamma g R \text{ inlet } T_t'} \right.$$

$$\left. \left[1 - \left(\frac{\text{inlet radius}}{\text{exit radius}} \right)^2 \right] \right|^{\gamma/\gamma - 1}$$

Loss Parameter:

$$LP' = \frac{\bar{\omega}' \cos(\text{exit } \bar{\beta}')}{2\sigma} \quad \text{(rotor)}$$

$$LP = \frac{\bar{\omega} \cos(\text{exit } \bar{\beta})}{2\sigma} \quad \text{(stator)}$$

Diffusion Factor:

$$DF = 1 - \frac{\text{exit } V'}{\text{inlet } V'} + \frac{\text{exit } DV_\theta' - \text{inlet } DV_\theta'}{(\text{exit } D + \text{inlet } D)\sigma \text{inlet } V'} \quad \text{(Rotor)}$$

$$DF = 1 - \frac{\text{exit } V}{\text{inlet } V} + \frac{(\text{inlet } DV_\theta - \text{exit } DV_\theta}{(\text{exit } D + \text{inlet } D)\, \sigma \text{inlet } V} \quad \text{(Stator)}$$

Adiabatic Efficiency:

$$\eta_{ad} = \frac{PR^{\frac{\gamma - 1}{\gamma}} - 1}{TR - 1}$$

Deviation Angle:

$$\delta^\circ = \beta_2^* - \beta_2 \quad \text{(rotor)}$$

$$\delta^\circ = \alpha_3^* - \alpha_3 \quad \text{(stator)}$$

Surge margin:

$$\% \, SM = \left[(PR_{surge} - PR_{given\ point}) / PR_{given\ point} \right]_{at\ constant\ flow} \times 100$$

Carter's Rule

Deviation System

Carter's rule plus an experience factor was used to obtain deviation for both the rotor and stator. The form of Carter's rule that was used is given below:

$$\text{Carter's rule deviation (M114 deviation)} = \frac{(\Delta\beta - i)\, m_c \sqrt{\frac{1}{\sigma}}}{1 - m_c \sqrt{\frac{1}{\sigma}}}$$

$$m_c = 0.92\,(a/b)^2 + 0.002\,\beta_2$$

$$\frac{a}{b} = \frac{\text{distance to maximum camber point from leading edge}}{\text{chord}}$$

Delta deviation = M114 deviation − actual deviation

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